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TWENTY-SEVENTH ANNUAL REPORT 1953

CENTRAL STATES
FOREST EXPERIMENT STATION
Columbus 13, Ohio
W. G. McGINNIES, DIRECTOR

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CENTRAL STATES FOREST EXPERIMENT STATION

1953

At the end of each year it is customary for any organization to reflect upon its accomplishments, reconsider the job yet to be done, and readjust its plans for doing the job. When all this is written down, it becomes the "Annual Report."

In the following pages are to be found reflections, considerations, and suggestions summarized as the Annual Report for the Central States Forest Experiment Station for the year 1953.

Although our over-all research program is planned, directed, and coordinated from the headquarters in Columbus, Ohio, most of the field work originates from our Research Centers and Experimental Forests located throughout the region.

Historically, the Central States region has been famous for its high-quality hardwood timber. The best timber is gone, however, and although the growing potential is still there, the woodlands that remain are generally made up of poor-quality trees. So the first step in rehabilitating the forests is to remove these poor trees from the woods to make room for good ones. But unless this job can be done at a profit, there is little chance that it will get done at all. Therefore, the utilization of low-grade hardwoods ranks high in our research plans. At our Carbondale Research Center in southern Illinois, a major project is rapidly taking shape to deal with this broad problem. In cooperation with Southern Illinois University, a wood-processing pilot plant is being set up to test and develop methods for using previously unmarketable material.

In dry seasons, the forester is perennially beset by a big worry--fire. The drier the woods the more alert and efficient must be the fire prevention, detection, and control organization. Our forest fire research activities are centered at the Northern Ozark Forest Research Center in Missouri. Here, in cooperation with the national forests in Missouri and Illinois, emphasis is being placed on predicting where and when fires are most likely to occur. If it is known that the chance of a fire starting in a certain area is greater under certain conditions and at certain times, the fire control crews can be more strategically located and more readily dispatched.

Much of the forest land in the Central States is in small tracts. In many ways, managing a small woodland is similar to

managing an extensive forest. So the results of most of our research are generally applicable to forests of any size. However, small-forest management does have some unique problems that require special study. Greatest emphasis is placed on this phase of forestry at our Ames Center in Iowa.

An important task of the Forest Service as a whole is to take inventory of the nation's forests and keep this inventory current. The initial phase of the Forest Survey in our territory is rapidly nearing an end. The field crews are now operating in Iowa and when that State is finished there remain only the forested parts of Kansas and Nebraska to be done. Results of the Ohio survey are being compiled and will be published soon.

The Station maintains a one-man consulting service to help wood-using industries solve their utilization problems. This specialist keeps in close touch with the Forest Products Laboratory so that new developments in wood processing can flow from the laboratory to the mill as quickly as possible.

Insects and disease, although not so spectacular in their workings as fire, are equally destructive to the forest. In fact their very insidiousness makes them all the more dangerous. So it was with pleasure that, during the recent reorganization of the Department of Agriculture, we welcomed a group of entomologists and pathologists, formerly of the Bureau of Entomology and Plant Quarantine and the Bureau of Plant Industry, to our staff. Their talents will be put to good use in helping to solve some of the region's forest insect and disease problems.

Drought Points Up Need for Water Research

1953 was a year of drought and water shortages in the Central States region as well as in many other parts of the country. When water is at a premium, the importance of managing the land with an eye toward increasing and utilizing its water-producing capacity becomes strikingly evident. As water levels in reservoirs sink lower and streams dry up, farmers, city-dwellers, and industrialists alike become concerned over the water supply and begin to ask questions: "Why is this happening?" and "What can be done to prevent it?" Such demands by the public lend import and impetus to the research being done and being planned by the Central States Station.

Although our primary interest is the production and utilization of forests, the influence of a forest upon its environment, particularly upon the flow of water, is becoming recognized more and more as a part of the forester's realm. Indeed it is impossible today to manage a forest without considering its relationship to water. Many of our studies are designed to give forest-soil-moisture

information, and some of them (chiefly at our Buckeye Research Center in southeastern Ohio) are aimed specifically at solving water problems.

But we are convinced that much more research is needed to provide a sounder basis for better watershed management. Our present studies are too limited to furnish the broad information needed soon enough to meet the ever-growing demand. We are recommending that our forest-influences program be stepped up rapidly as funds may become available.

The details of the work discussed above, as well as other phases not mentioned, are given in the following pages. In addition, our plans for the year ahead are outlined. A list of publications issued during 1953 may be found on pages 58-63.

THE CENTERS REPORT

AMES CENTER

The Ames Forest Research Center serves 72 million acres of the Corn Belt where the forestry problems are truly those of farm-woodland management. All of Iowa and comparable forest types in adjoining portions of northern Missouri, northeast Kansas, eastern Nebraska, southeastern South Dakota, southern Minnesota, southwest Wisconsin, and northwestern Illinois are within the province.

Practically all of the forests in the province are privately owned. They are generally operated in conjunction with farms. Less than 8 percent (5,367,000 acres) of the land in farms is classified as forest or pastured woodland. Only a limited number of private forest holdings are larger than 100 acres and the average is 45 acres for farms having woodlands. Thus, the problems of the Ames Center are not those normally associated with large forest holdings; the program is aimed at the problems of small woodland management and establishing forests on land that logically should be in timber production.

The Ames Center operates as a cooperative undertaking. The closest cooperative bond is with the Forestry Department of the Iowa Agricultural Experiment Station and Iowa State College. The Center Headquarters are located in the Forestry Department at the College; Brayton Memorial Forest, owned by the College, is used for cooperative studies. The arrangement is ideal for coordinating effort and avoiding duplication of activities. The Forestry Department provides funds for labor and equipment operation on several of the cooperative projects.

The Amana Society, a private corporation in east-central Iowa, is also making a major contribution to the Ames Research Center program. The Society has set aside on a free, 20-year lease, 3,100 acres of forest land for the Center to use as an experimental area. The Society also furnishes the labor and equipment required for harvesting products on the study areas.

The forestry problems of the province are those normally associated with the management of small woodland areas, the utilization of comparatively small lots of primary forest products, and the forestation of land that should be in timber production.

The tendency for leaving cull trees and low-quality species in the stand at time of harvesting; the strong sprouting characteristics of the native hardwood species, especially such less desirable species as the hickories; the tolerance of undesirable species such as American elm; the practice of heavy and continuous pasturing of the woods; inadequate protection against fire; and the failure

to recognize the important part forests play in the total economy have all contributed to deterioration of the forest stands. As a result, the forests are populated with too many undesirable species and low-quality trees of little or no commercial value. Even the better stands are being replaced by unwanted species in the understory.

BUCKEYE CENTER

The Buckeye Forest Research Center at Athens, Ohio, is maintained to study and find practical solutions to the forest management and forest-influences problems in Ohio and the bordering counties of Kentucky, West Virginia, and Pennsylvania.

In forest management research, the Center seeks to determine methods for attaining maximum production of high-quality wood from the forest land. Specific problems include: (1) Establishing trees on old fields and strip-mined land, and the study of planting stock grade requirements and related factors including sources of seed; (2) developing silvicultural systems for our present forests that will favor adequate natural regeneration of valuable species; (3) improving the growing stock in our present forests; (4) determining optimum stocking for the present forests to assure maximum production of quality wood material for the future; (5) determining site requirements of species that are native or commonly planted in the area; (6) determining the management methods needed to keep the plantations of the area in a productive condition; (7) determining logging equipment needs and efficient harvesting techniques for both large and small forest-land owners in the problem area; (8) and finding ways to utilize low-grade or small material that will result from needed improvement cuts in many stands and plantations.

In forest-influences research the Center endeavors to determine methods of forest management that will assure maximum benefits from the forest in terms of soil stabilization, regular water flow, and quantity and quality of water yield. About 40 percent of the hilly unglaciated section of the area is forested and many tributary streams of the Ohio River have their source in this region. The condition of this land and its watershed value are of great concern to the people of the region. How important are forests in flood control? How effective are the forests in maintaining the ground water level? How should the forests be managed to maintain favorable soil and water conditions and also supply wood for the region? The answers to these questions are the concern of the forest-influences research program in the Buckeye area.

CARBONDALE CENTER

The most pressing problems in on-the-ground management phase of the Carbondale Research Center's activities are concerned with renewing, conditioning, growing, and managing native hardwood forests. These include handling small woodlands, rehabilitating large areas of depleted forests, and developing silvicultural and management systems best adapted to both the forests and economic conditions. Involved are the response of forest stands to various cutting practices, the behavior of individual trees, methods of obtaining desirable reproduction after cutting, growing of specific products, and cost and returns. On unforested areas, old fields, and coal-stripped lands, the over-all problem is to develop ways to successfully produce new forests under often difficult conditions. This involves correct planting methods, species selection, and includes the study of superior strains, hybrids, or seed sources which may be better adapted to bare or unforested areas. Developing proper management practices for planted forests (plantations) also requires research.

Another phase of management, extremely important to the economic and silvicultural rehabilitation of low-value stands, is the recently initiated "costs and returns" study. This study is designed to determine the possibilities of removing at a profit much of the present large volume of woods waste. The problem will be approached from at least three angles: (1) More efficient harvesting operations, (2) woods processing of low-grade logs into small-dimension, primary products to avoid transport costs of cull material, and (3) finding new uses for and expanding present uses of low-grade lumber and small-dimension products through secondary processing--all this at a profit not heretofore obtained.

In southern Illinois and similar adjacent areas served by the Carbondale Forest Research Center, approximately one-third of the total land area is in forests. An additional one-third may eventually become forest land. In this area, growth exceeds drain by nearly 50 percent but quality of the reserve is low. The economic potential of the forest resources of this area is not being fully realized although it does make a significant contribution. For example, railroad shipments of lumber and forest products from southern Illinois in 1951 ranked fifth out of 10 commodity groups. The need to more fully manage, protect, and utilize the products from two-thirds of the land is made even more urgent by the area's relatively low economy. Based upon the average of 10 standard-of-living indexes, southern Illinois has the lowest standard in the State. It also has the heaviest relief load. Thus, it is definitely an area of critical unemployment.

During its first 6 years, the Carbondale Forest Research Center concentrated on: (1) Major forest management problems

involving rehabilitation, management, and regeneration of native hardwood forests; (2) plantation management; and (3) forestation of old fields and coal-stripped lands. In 1952 Congress appropriated additional forest management funds for the Carbondale Center, to initiate investigations in the utilization of hardwoods to facilitate management of forest stands, in cooperation with Southern Illinois University.

NORTHERN OZARK CENTER

Originally, the Northern Ozark Center was established to conduct research in forest and range management in the Missouri Ozark highlands. Later a one-man fire research project was added in cooperation with the National Forests in the region. In addition to this work, responsibility was assumed for the coal-stripped land reclamation research begun earlier in west-central Missouri, southeastern Kansas, northwestern Arkansas, and northeastern Oklahoma.

The Missouri portion of the area serviced by the Northern Ozark Forest Research Center includes about 14.2 million acres of forested land. Most of these forests are in the Ozark and Ozark-border regions where about 55 percent of the area is forested. Most Ozark forests are privately owned and are grazed at least part of the time. The best natural rangelands of the Ozarks are the sparsely timbered "glades" which occupy about half a million acres in southwestern Missouri. Also, native range plants constitute the main forage resource on much of the cleared land in the Ozark area. Unrestricted grazing is the rule on about four million acres of legally open or "free range" in the heavily wooded, grass-poor eastern Ozark counties and on many private forests outside the free-range area.

Although research was begun in the mid-thirties on a limited scale, the Center was not established until 1948. Many of the results of the early studies are already in wide use in the area. Close cooperation is maintained with the Forestry and associated departments of the University of Missouri and with other State agencies interested in forest conservation. Research on the Sinkin Experimental Forest is directly supervised from a field station at Salem. Three major forest types are involved in the research work: Shortleaf pine, mixed shortleaf pine and hardwoods, and mixed oaks and hickories.

Livestock grazing is a major source of income for Ozark farmers. On forested range, grass yields are highest and range cattle do best where the tree cover is sparse. Obviously, high timber yields and high forage yields do not occur together. The conflict between grazing and forestry interests is a major problem. Criteria are needed for determining which lands should be

in trees, which in grass and which can be used for either. On land devoted primarily to grazing, research is needed to determine the best methods for controlling woody plants and to work out systems of revegetation and management that will build up and maintain range productivity. Range research has a high priority in the Ozarks because Ozark farmers derive more than three-fourths of their income from livestock and livestock products.

Perhaps no other section is in greater need of fire prevention and control research than the Ozarks. Historically, the whole area has been open range, and, the land has been burned repeatedly with the idea of stimulating forage production. Furthermore, the Ozarks region lends itself to drought. Topography is steep and adds to quick surface runoff; and geologic structure is such that in most areas subsurface drainage is rapid. Most of the precipitation comes in the winter and spring. Summers are usually dry, and occasionally an extreme drought occurs.

The extremely dry weather in the summer and fall of 1953, like the "ill wind," was not without its advantages. It provided an opportunity to study some of the forestry problems associated with moisture, such as fire danger and behavior, and moisture relations of soils and fuel under the adverse conditions created. Dry summers are common and periods of dry weather occur almost every summer in the Missouri Ozarks. Since they cannot be predicted, their probable occurrence must be taken into consideration in the management of forest and range resources. Information obtained from studies during these dry summers is therefore significant.

The dry periods frequently experienced in the Missouri Ozarks do not affect forest crops as seriously as most other crops. The root systems of trees are more extensive and draw water from a larger volume of soil. Also, since the dry periods usually occur in the summer and since trees grow most rapidly in the spring (particularly in height), growth has usually stopped before the moisture supply becomes critically low. The extreme dry summer does take its toll in mortality of new seedlings and reduced growth of forest trees as will be pointed out later.

FOREST MANAGEMENT

In a broad sense, forest management research is aimed at helping to achieve the best use of land. More specifically, research in this field is concerned with increasing the yield and quality of forest products and attaining greater net returns. The major phases of study in management are regeneration, silviculture, measurements, costs and returns, and genetics. However at present the closely allied fields of forest grazing, protection against fire, and influences are supervised generally and to some extent technically by the Management Division. The work in these and other fields is coordinated and integrated by this Division also.

The Central States region coincides generally with the Central Hardwoods region and has broad types extending its length and breadth. Within this region, much more than half of the timbered land is in small holdings, there being only a few large forest ownerships, including both public and private. Because of broad types it is necessary to investigate forest problems on a regional basis. But it is also necessary to investigate more localized problems cooperatively, as far as possible, with state and private agencies and to coordinate local findings with those on a broader scale. From these studies, principles for regional or broad application and principles for more local application are developed.

Most of the technical staff doing research on the ground is located at four Research Centers or field stations; this decentralized system is designed to make most efficient use of available funds.

These field stations are provided office and laboratory facilities without charge by Iowa State College, the University of Missouri, Southern Illinois University, and Ohio University. The total value of services and other contributions received from both public and private cooperators is at least equal to the Station's contributions to forest research in the region. At present five experimental forests have been established (averaging about 3,500 acres each), and are operated by the centers. Two are in National Forests, one in a State Forest, and two on private land. In addition, many scattered small experimental areas on both public and private land are used for lesser projects. One of the largest forest areas, eastern Kentucky, and perhaps the most important potential producing area of the region, is not yet serviced by a research center.

One of the foremost objectives of research, and perhaps the most difficult to attain, is getting results applied. But unless the results of research are applied, the purpose for which the work is done is defeated. Effort and progress have been made during

the year to see that maximum use is made of research findings. Stress has been placed upon reporting information as soon as possible after it becomes available, and upon the readability of the reports. The Station is leaning heavily toward simplified instructions and the "How-to-do-it" type of paper whenever feasible. Demonstrations are maintained at the experimental forests where all who wish may visit. Working closely with the National Forests, forest schools, state divisions of forestry, and extension and private agencies is another effective way to spread research results. Plans are being laid to further expedite the application of better management practices by forest owners.

MANAGEMENT

Under this heading are reported progress and accomplishments in those studies concerned with the management of forests, with emphasis on the business and economic aspects.

Cutting Cycle Comparisons in Iowa

A study is underway to determine and demonstrate the biological effects and financial returns from cutting upland mixed oak stands every 1, 5, or 10 years. It is on the Brayton Memorial Forest and conducted cooperatively with the Forestry Department of Iowa State College.

Yield data and costs were summarized for the first cuts in all plots and for the second cut in the annual harvest plot. The costs, as summarized, are based on Forest Service equipment rental rates and so are not directly comparable to the costs that would be incurred by a private operator. They will be converted to private operator costs for future comparisons. The trees in the plot where annual harvesting is being done were marked during the fall of 1953 for the third cut.

Fuelwood Production Costs

The costs of converting hardwood logging slash into 16-inch fuelwood were found to be $6.48 per ton, or $14.62 per standard cord, in September 1952. Labor and equipment use were determined in a cooperative study with the Forestry Department of Iowa State College on the Brayton Memorial Forest.

Labor costs averaged $1.03 an hour. Thus, a farm-woodland owner could cut fuelwood from slash and sell it at his farm for $6.50 a ton and earn approximately $1.00 an hour for his time in the woods if his equipment costs are about the same as those used in the study. Making fuelwood from standing trees would probably cost somewhat more because of the added cost of felling.

Further details of this study will be covered in a Station Note to be issued early in 1954.

Yield from Low-Grade Logs

A summary was completed of the yield of railroad crossties and side lumber secured from low-quality tie logs harvested in 1952 on the Brayton Memorial Forest. The logs came from a stand improvement cutting and salvage of trees killed by the oak wilt disease. A paper reporting on the yield is planned for issue at an early date.

Log Grades and Yields

This study of grades of logs found at representative sawmills in Iowa and the yield of lumber by grades from the logs has been completed. It was a cooperative study with the Forestry Department of Iowa State College and a manuscript of a paper reporting the results of the study has been submitted to the Forestry Department for review prior to publication.

Handling Small Woodlands

Three small tracts of hardwoods have been set aside at the Kaskaskia Experimental Forest in southern Illinois for farm-woodland management demonstrations. Treatments are being applied to all the areas. Results for the first few years of managing two of these tracts, the "good" and the "poor" woodlands, were reported in Technical Paper 133.

Management of the third farm-woodland demonstration was started last year. This tract is located in the stream-margin hardwood type and is being operated in cooperation with Southern Illinois University. All cull trees have been eliminated, a small open field has been planted to black locust and yellow-poplar and some of the harvest trees have been marked for the first cut.

In cooperation with the Illinois Agricultural Association, State Cooperative Extension Service in Agriculture and Home Economics, and Southern Illinois University, the first farm forestry field day was held at the Kaskaskia. Approximately 40 farmers, farm leaders, sawmill operators, foresters, and others spent the day in reviewing demonstrations and in discussing the management of small woodlands.

Study of Management Systems by Compartments

This comprehensive, long-term study is the major management research project at the Kaskaskia Experimental Forest. It includes 36 compartments, averaging about 20 acres each. These are being

used to test silvicultural systems, length of rotation, cutting cycle, intensity of management, and planting conifers for stand conversion. To date, 27 compartments have received their first complete treatment. During the past year, four compartments were given their assigned treatment. On two of the compartments being used to test stand conversion, shortleaf pine previously planted in openings was released from brushy competition. Technical Paper 134, published during the year, summarized the early results of stand conversion experiments.

Forest Management Unit

The initial management plan for a 400-acre forested tract at the Kaskaskia Experimental Forest in Illinois was completed during the year. The tract was divided into 10 compartments and the boundaries marked. This area will be managed as a pilot plant, using the best known forestry practices but with streamlined and economical application and control. Three of the compartments were given a rehabilitation cutting and girdling treatment during the year.

Cost of Girdling Hardwoods

During the past few years more than 400 acres of hardwood timber in Illinois have been given a girdling treatment as a part of forest management studies. The average upland stand had about 15 square feet basal area of cull trees per acre that was contained in 31 pole-size and 6 sawtimber-size trees. Axe girdling into the sapwood was done at the rate of 6.5 square feet basal area per man-hour for upland timber and 10.9 square feet for bottom-land timber. For uplands this amounted to 2.3 man-hours per acre. On bottom lands the time was 4.8 man-hours per acre but many more culls were girdled. For upland timber the girdling time can be estimated by either of the following formulae:

Man-hours = .008 times the sum of diameters in inches.
Man-hours = .115 times basal area in square feet.

For the bottom lands, Yocom's formula (Southern Forest Experiment Station) was found to fit well:

Man-hours = .005 times the sum of diameters in inches.

This subject was covered in two publications issued during the year: "Girdling time for hardwoods," Station Note 77, and "Estimating girdling time," Journal of Forestry 51:824-825.

SILVICULTURE

Progress and accomplishments in those studies concerned with the reproduction and growing of trees and the development and tending of forest stands are reported in this section.

Epicormic Branching of Oaks

Limbiness of trees affects the quality of products obtained from a forest. The number and size of knots or other defects determine the grade of a log. Since thinning of stands may influence branch development, a study was established in oak-hickory stands of sprout origin in southeastern Iowa to find out how many epicormic branches develop on the main stems of the oaks after the stands are thinned, and how fast these branches grow.

Observations were made of branch development on the first 17-foot length of the stems of crop trees that were 25 or 50 years old at the time of thinning. The first data were obtained three growing seasons after thinning and additional data were obtained after the fourth growing season. The study shows a significant increase in number of branches for all oaks in both stands and in branch development on white oaks (fig. 1) as intensity of thinning increased.

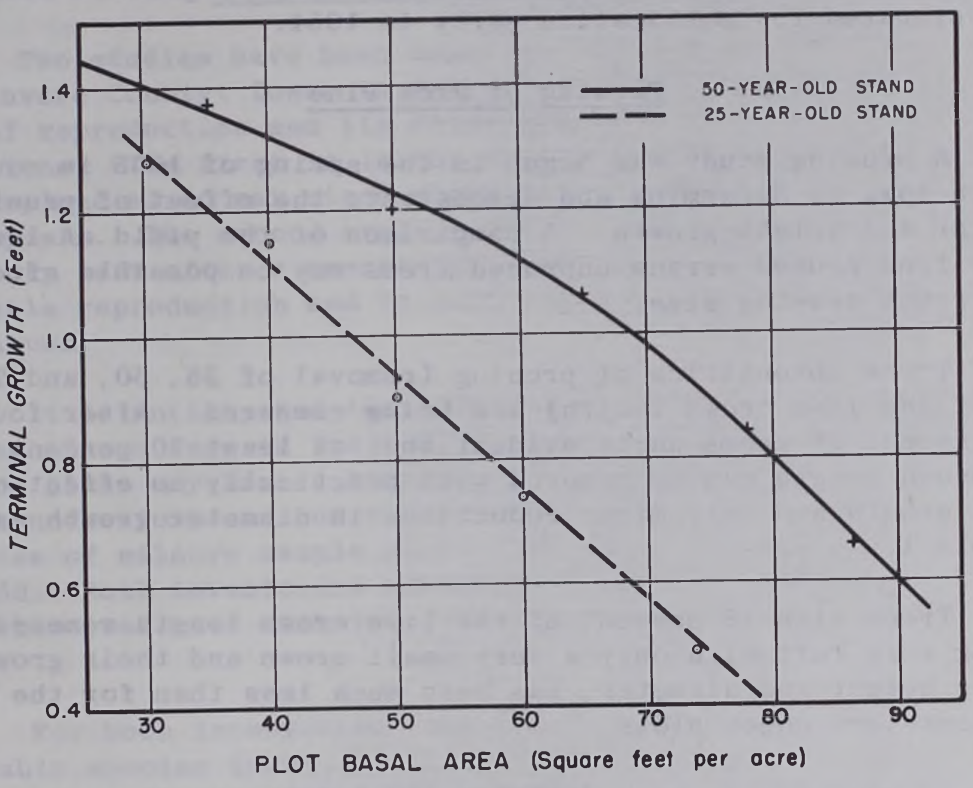

Figure 1.--Average terminal growth per epicormic branch in first log of white oak crop trees for three growing seasons.

There was an inverse correlation between branch growth in length and intensity of stocking in both the 25- and 50-year-old age classes for the first three growing seasons. As stand basal area increased branch development decreased.

Preliminary analyses also indicated a direct relationship of branch occurrence and development with diameter growth and with the origin of the trees. In the heavily thinned stands where the growth rate increased considerably, the trees produced more and faster growing branches than the slower growing trees in the denser stands. Trees left as a result of removing part of the sprouts from a stump also produced more branches than trees that originated as seedlings or as seedling sprouts.

Practical application of this information in the management of white and black oak species indicates that the woodland owner or forest manager must decide what product he wishes to grow. If he prefers faster growth and is not greatly concerned about quality, he can thin rather heavily and disregard the epicormic branching that occurs. But if he wishes to grow high-quality products comparatively free of knots and twig blemishes, he will have to be satisfied with slower growth and thin his timber stands lightly.

A technical paper reporting this study in greater detail is being prepared for publication early in 1954.

Pruning of Jack Pine

A pruning study was begun in the spring of 1948 in southeastern Iowa to determine and demonstrate the effect of pruning on diameter and height growth. A comparison of the yield of lumber by grades from pruned versus unpruned trees may be possible after the trees reach saw-log size.

Three intensities of pruning (removal of 25, 50, and 75 percent of the live crown length) are being compared. After four growing seasons, it seems quite evident that at least 50 percent of the live crown length can be removed with practically no effect on height growth and only minor reductions in diameter growth as shown in table 1.

Trees with 75 percent of the live crown length removed by pruning were left with only a very small crown and their growth, both in height and diameter, has been much less than for the other treatments and check plots.

A reduction in both diameter and height growth occurred in all treatments during the 1950 and 1951 growing seasons. This was apparently due to the plots being overstocked. Consideration will be given to thinning the plots when they are remeasured and repruned

early in 1954. A progress report will be prepared after the growth data are summarized.

Table 1.--Average growth of jack pine by 2-year periods as influenced by degree of pruning

Degree of pruning (Percent of crown length)	Height growth		Diameter growth	
	1948-1949	1950-1951	1948-1949	1950-1951
	Feet	Feet	Inches	Inches
0 (check)	4.20	3.39	0.62	0.25
25	4.17	3.89	.58	.30
50	4.05	3.39	.50	.33
75	3.39	2.83	.24	.13

Reproduction Following Cutting

Two studies have been begun on the Brayton Memorial Forest in Delaware County, Iowa, to determine changes in the amount and kind of reproduction and its development following harvesting operations. The first is in the series of cutting-cycle study plots in an upland mixed oak stand where harvesting is done every 1, 5, or 10 years. The second study is on a bottom-land tract where the overstory left after a commercial clear cut was removed to release desirable reproduction and to permit additional seeding of the bare areas.

It is anticipated that the frequency of cutting and differences in size of openings in the canopy caused by the 1-, 5-, and 10-year cutting plans may have a bearing on the amount, kind, and growth of the understory and new reproduction in the plots. To test this, a series of milacre sample plots were inventoried in 1952 and again in 1953. Both inventories showed very few new seedlings of oaks in either year even with two good seed crops for the black oak group.

For both inventories, the average number of seedlings of desirable species (oaks, black walnut, basswood, cherry, and ash), was 1,440 per acre on the north slopes and 3,370 on south slopes. This number of preferred species seems adequate until it is compared with the average of 12,000 stems per acre of less desirable tree and woody shrub species competing directly with the preferred

trees. The effectiveness of this unfavorable competition was already evident since undesirable species were dominant on 73 percent of the milacre sample plots.

The study also indicates that the relative dominance of the separate species may be related to aspect. On south slopes, desirable species were dominant on 33 percent of the milacre samples while only 22 percent of the milacres on north slopes had desirable species in the key positions.

No particular differences in species, number of stems, or increases in reproduction growth were evident under the three different cutting cycles. It is probably too early to notice any difference that may occur as a result of the different harvesting plans.

The bottom-land study was designed to determine, periodically, any changes occurring in composition, size, and stocking of reproduction and the relative dominance of each species. Condition classes to be studied include (1) areas well stocked with reproduction in 1953, (2) undisturbed areas that currently are understocked because of previous grazing, and (3) areas recently disturbed by logging operations where reproduction is absent or very limited.

Plots were established during the year in the three condition classes and the data analyzed for the files. In condition class 1 --areas well stocked with advanced reproduction--from 1,500 to 15,000 trees of preferred species existed per acre. No new reproduction was evident the first year after clearing on the undisturbed pastured areas or on the disturbed areas such as logging roads. This may have been because there were no spring floods in 1953.

Both areas will be reinventoried in the fall of 1954 if observations indicate there is an increase of new seedlings.

Crown Competition Index

For the greatest returns from forest lands, stands should be held at stocking levels that produce maximum quantity and quality of merchantable material. Optimum stocking still is unknown for most species and sites. One reason for this may be that the present techniques used to evaluate stocking or to maintain it at the optimum level have serious limitations.

This year a somewhat different approach was undertaken at the Ames Center to determine and describe a consistent measure of stocking for a given species or species group regardless of age, site, or diameter class distribution.

The index is based on the concept that open-grown trees have crown cross-sectional areas that are related directly to their

stem diameters. From crown and diameter measurements of a number of such trees, the minimum number of trees of a given d.b.h. which would be required for a complete canopy and full use of an area can be determined. Progressive increases in the number of trees of a given diameter above that minimum would result in similar increases in stocking density up to the maximum for the species.

For example, if the minimum number of 12-inch white oaks required for a full canopy was found to be 100 per acre, the maximum number a natural stand could carry might be nearly twice that. Optimum stocking would lie somewhere between the two extremes, perhaps 130 to 150 12-inch trees per acre. Furthermore, if the relationship held for each diameter class when considered separately, it might apply when diameters were mixed as in natural stands. Following through on this premise, an experiment has been set up and a report on the early phases will be published in 1954.

Stand Density for Optimum Growth

A large portion of the upland forests in southeastern Iowa and northeastern Missouri has been clear cut or heavily cut in recent years for railroad ties, mine timbers, and other products. The sprout stands resulting from these operations are composed of even-aged, mixed oaks and hickories and are generally overstocked. Growth is slow, averaging about 10 or 11 rings to the inch for 25-year-old trees and many more for older trees.

A major hindrance to proper management of these stands is lack of knowledge of the stocking that will maintain maximum growth of the products desired. In order to provide this information, a study was begun in southeastern Iowa in the fall of 1949.

Plots in a 25-year-old stand were thinned so as to leave 30, 40, 50, and 60 square feet of basal area per acre; plots in the 50-year-old stand were thinned to 35, 50, 65, and 78 square feet. Untreated plots were established in both stands.

The trees were remeasured in 1953, after four growing seasons. Diameter measurements show that the trees in the thinned plots are growing about twice as fast as those in the unthinned plots. Growth during the first 4 years has been about the same for all treatments but it is expected that later measurements will show a decrease in diameter growth sooner in those plots having the greater basal area.

The next remeasurement of these plots is scheduled for 1955. If time permits in 1954, an additional 20 crop trees will be numbered in each plot of the 25-year-old stand to provide a more exact measure of the growth of individual trees.

Harvesting Low-Grade Trees

Harvesting low-quality trees and low-grade species for specific products can be profitable. It can also provide a means of releasing desirable reproduction and save the usual costs of girdling, poisoning, or otherwise removing the overstory of undesirable trees. This was demonstrated in a cooperative study with the Forestry Department of Iowa State College on approximately 20 acres of bottomland timber in the Brayton Memorial Forest.

The area had been cutover in 1944 removing all merchantable saw logs and veneer. Only defective trees of desirable species and the unmerchantable species were left. Most of the residual trees had no value in the normal markets for saw logs and veneer even though the trees contained some sound volume in short lengths.

However, a market was located nearby for egg-case veneer bolts 12 or more inches in diameter and in 27-inch lengths or multiples thereof. Practically all of the larger trees were suitable for this special use and a few yielded 8-foot saw logs. A total of 54,897 board-feet (International 1/4-inch rule) of bolts and 8-foot logs were cut from the 20 acres. They were sold, decked in the forest, for an average of $30.93 per thousand board-feet.

After costs were deducted, the operation showed a profit of $28.05 an acre of $10.22 per thousand board-feet of logs sold. Thus, stumpage that had no apparent value was converted into a nice profit and the usual cost of removing the overstory to release reproduction was saved. In addition, if the sale had been made by a woodland owner and operator, the job would have paid the woodland owner more than $1.00 an hour for his time in his woods.

A Station Note reporting additional details of this study will be issued in 1954.

Thinning a 50-Year-Old White Pine Plantation

The plantation on the Amana Experimental Forest, where thinning and growth-response studies are underway, was damaged during the year by an ice and sleet storm. The tops were broken out of some of the trees and the crowns of others were reduced.

Condition of the stand and possible recovery of the trees will be considered in 1954 and a decision reached whether to continue the studies.

Wood Chips to Utilize Wastes

The possibilities for using logging and sawmilling wastes to produce wood chips suitable for livestock bedding, chicken litter,

and mulches were demonstrated to about 100 Iowa farmers attending a conservation field day at the Homestead farm of the Amana Society.

The portable chipper available at the Ames Center has not proved satisfactory for producing chips efficiently or economically. Consequently, no cost studies of production or other work with chips is planned.

Mortality of Bigtooth Aspen

The bigtooth aspen plots in northeastern Iowa were re-examined in 1953 and no great change in mortality from that previously reported was observed in either the 50- or 80-year-old stands. The plots will be checked again in 1955.

Management of Upland Hardwood Forests

In 1953 two studies designed to give preliminary information for managing the upland hardwood forests of the region were begun on the Vinton Furnace Experimental Forest in southeastern Ohio.

One study (chiefly a demonstration) will provide comparisons between six methods of hardwood management. Three plots have had all trees of merchantable value cut. One of these plots will be left in this condition without further treatment; a second plot will have all the remaining trees cut; and the third plot will have an improvement cut made in the residual stand leaving only trees that appear to have potential value.

The three remaining plots are to be cut selectively. One plot will be cut to remove all trees larger than specified diameters by species; a second plot will be cut to remove inferior, defective, or mature trees that should be removed to improve the stand; and the third plot will be cut on the same basis as the second plot, but will be given additional treatment to improve growing conditions in the stand such as girdling or poisoning unmerchantable and undesirable trees, planting openings, and thinning clumps of young growth.

About 60 percent of the cutting on the above plots was completed in 1953 and it is expected that all cutting will be completed by the spring of 1954. In addition, reproduction counts were made on one of the clear-cut plots in the fall of 1953. Three months after the commercial clear cut was completed on this plot there were more than 8,000 seedlings and sprouts of commercially valuable species per acre.

This study of methods of hardwood management will provide on-the-ground comparisons between the results of several cutting treatments. Logging costs and records of material cut are being kept

separately for each plot and, when the study is completed, records for an over-all area of 50 acres will be available for analysis. The study will also provide information that will be very helpful in designing more comprehensive studies of this same nature.

A second study begun in 1953 is designed to compare hardwood versus pine management on ridge sites. Three blocks of three plots each were established. Two plots in each block were clear cut of hardwoods and will be planted to a mixture of white, red, and pitch pines. One pine plot in each block will be released from competing hardwoods and the other plot will not be released. The third plot in each block is to be kept in hardwoods. A comparison will be made between the cost of managing each plot and the value of the products yielded. The physical effects of conversion on the soil-water relationship on the treated area will also be studied. The cuttings were largely completed in 1953 and the pine plantings will be made in 1954.

Site-Index Meter for Oaks

In 1953 a design for a white oak site-index meter was published in the Journal of Forestry. This meter, based on data given in a previous Technical Paper by R. N. Gaiser, enables the user to estimate the quality of a given site for white oak by evaluating soil depth, position on a slope, and direction of exposure. It is easily made with a block of wood and a cheap hand compass; reprints of the meter face and back are available upon request from the Central States Forest Experiment Station. The meter may be used to evaluate planting sites for white oak as well as to estimate the site index in forest stands.

A manuscript describing a stocking guide for white oak received an in-service review in 1953. The report concerns the use of a tree-crown-area factor that indicates growing area needed for white oaks of different ages over a range of sites. The factor is derived from data collected from white oak stands in the unglaciated portion of the problem area. The factor will be tested in a stocking study next year.

Growth and Mortality in Cut and Uncut Stands in Illinois

Upland hardwood stands, in which the mature and inferior trees were removed and the best and most thrifty growing stock was left, have shown excellent growth response. Adjacent untreated stands had a much lower net growth and a much higher mortality rate.

A 25-year-old cottonwood stand showed remarkable growth and change in stand structure in the 4 years between measurements. During that period the original cottonwood basal area of 138 square feet per acre increased only 6 percent but volume increased 1,663

board-feet per acre per year. The dynamic behavior of this bottom-land stand was reported in detail in Station Note 75.

Release and Pruning of Young Hardwoods

A review of literature and problem analysis dealing with artificial pruning and cleaning of young upland hardwoods was completed and processed for distribution. Available evidence indicates that these treatments may well become important phases of management in the upland hardwood forests of this area.

A detailed study of the response of white oak pole-size trees to full release was begun in Illinois during the year. The study is designed to determine response to release as shown by growth and stem sprouting. This will be related to site, artificial pruning, crown class, past growth history of the tree, and other tree characteristics that may become evident. The results will aid in selecting pole-size white oaks for release and retention as growing stock. Data already collected show that bark characteristics are well correlated with growth rates of the immediate past. For example, white oak trees with thin, hard, tight bark that is light gray in color and has many cross breaks across the ridges are generally slow growing. On the other hand, trees with thick, soft, flaky bark, darker gray in color and with few cross breaks usually grow faster.

Reproduction of Bottom-Land Hardwoods

In cooperation with the Shawnee National Forest, twelve 2-acre plots were established during 1952 in mixed bottom-land hardwoods to study cutting methods. A survey was made to determine reproduction on these plots before cutting. The survey showed 44 percent of the milacre plots to be stocked with seedlings and 14 percent stocked with saplings. It is expected that new reproduction coming in after treatment by some of the cutting methods being tested will greatly increase the number of seedlings and improve both the distribution and species composition.

Thinning and Pruning Plantations

During the year, six additional experimental blocks of a comprehensive shortleaf pine thinning experiment were established. The experiment will test four levels of stocking on three sites. This study is being made in cooperation with the Illinois Agricultural Experiment Station.

The first phase of a pruning experiment in shortleaf pine plantations was completed during the year. From 350 to 400 trees on each of sixteen 4/10-acre plots were pruned to 8 feet. Later, trees on these and other plots will be pruned to different heights.

Pruning about 900 trees per acre to 8 feet required an average of 19 man-hours. Average pruning time per tree was closely related to average tree diameter. For an average size of 3.0 inches d.b.h., pruning time was 1 man-minute per tree, but it increased sharply to about 1-1/2 minutes when the average became 4.0 inches d.b.h. Larger average sizes up to 4.6 inches did not increase pruning time per tree. When the average size was below 3.0 inches d.b.h., the time required per tree did not decrease further; it was more difficult to select crop trees and more of the live crown was removed in pruning to 8 feet. The general indication is that the best size for pruning to 8 feet is about 3 inches.

Demonstrations of Cutting Practices

Plans were drafted and work was started on thinning 33-year-old shortleaf pine stands on the Bunker Unit of the Sinkin Experimental Forest. The work involves a 60-acre portion of a section set aside for demonstrating forest management methods. These overstocked stands will be thinned to approximately 90 square feet of basal area of pine by a commercial sale of fence posts. The hardwood trees as well as hardwood reproduction and undesirable pine trees will be removed by cutting, girdling, or poisoning.

Plans are being made to set up demonstrations of four kinds of cutting practices on 5-acre areas in these young shortleaf pine stands. The cutting practices will range from merchantable clear cut to a light selective thinning including needed stand improvement.

Shortleaf Pine Stocking Study

All scheduled remeasurements and observations were made on the shortleaf pine stocking study and its many aspects including range, fire, and water. The study was expanded to include additional plots in planted pine stands.

The main objective of this study is to find out how growth is affected by thinning to different basal areas by different cutting practices and by removing competing hardwoods. Although it is too early for conclusive results, some interesting leads are evident.

Effects of Thinning on the Growth of Pine

In the comparisons shown in table 2, basal area of pine on the thinned plots was reduced from 140 to 70 square feet per acre during the 1951 growing season. All hardwood trees were removed on half of the plots in each intensity of thinning. All hardwood trees taller than 6 feet on these plots were either cut or girdled during 1951. Then in July 1952 all sprouts on these trees were sprayed

with herbicides and all other reproduction was sprayed at the same time. Thus there have been two complete growing seasons after thinning the pine and removing the hardwoods taller than 6 feet but only one complete growing season after the reproduction was sprayed.

Table 2.--Growth of shortleaf pine during 2 dry years, 1952 and 1953

Composition and basal area per acre		Average annual growth of pine			
		D.b.h. per tree		Basal area per acre	
Species	Square feet	1952	1953	1952	1953
		Inches	Inches	Square feet	Square feet
Pine[1/]	70	0.132	0.093	2.401	1.738
Pine	70	.127	.053	2.218	.927
Hardwood[2/]	12				
Pine[1/]	140	.057	.012	2.319	.474
Pine	140	.060	.009	2.520	.361
Hardwood	14				

1/ Hardwood trees more than 0.5 inches d.b.h. were cut or girdled during the summer of 1951 and trees 0.5 inches d.b.h. and smaller (about four thousand per acre) and new sprouts were treated with herbicides in 1952.

2/ All hardwood trees more than 4 inches d.b.h. or more than half the height of the codominant pine trees (a total of about 2 square feet basal area) were cut or girdled in 1951.

The rainfall from April 1 to October 31, 1952, was only 60 percent of normal but the damage was not too severe because the preceding years had more than average rainfall. The summer of 1953 was still drier with only 40 percent of normal rainfall. This was not only a record dry summer but was more damaging because it followed another very dry summer. The effects of this dry summer are evident in the table.

Removing half the basal area of pine increased the 1952 average diameter growth rate but not the basal-area growth rate of the residual stand over the original stand. However, although the basal-area growth did not differ greatly between stands, growth on the thinned stand was distributed among fewer and better trees. The removal of hardwoods resulted in no consistent change in diameter or basal-area growth rate.

The 1953 growth was not only much less than that for 1952 but it varied much more among treatments. The 1953 diameter growth and basal-area growth were increased by removing 70 square feet basal area of pine, 14 square feet basal area of hardwoods, and about four thousand trees less than 6 feet tall. Removing both the hardwoods and about half the pine increased the basal-area growth about five times. The increased basal-area growth resulting from the removal of hardwoods was about half as much as that resulting from the removal of 70 square feet basal area of pine.

Effects of Thinning on Soil Moisture in Shortleaf Pine Stands

The moisture content of the soil in the 12 plots discussed in the preceding section was studied during the summer of 1953 in cooperation with the University of Missouri Department of Forestry. The readings on the Delmhorst Moisture Meter ranged from 100 to 0. A reading of 100 represents approximate field capacity for most soils and 10 is close to the wilting point for most plants. Although the readings have not been converted to actual soil moisture, some idea of the relative amounts of moisture can be had by comparing the meter readings.

The readings started at about 100 on May 1 for all treatments and dropped, with small fluctuations caused by light showers, to about 0 by the end of August when the readings for all treatments were again about the same. From the latter part of May through August the readings for the plots from which the hardwoods were removed were consistently higher than those on plots with hardwoods. The greatest differences among plots occurred early in July when there was a range of 20 in the readings. Under these conditions the hardwoods (14 square feet basal area plus four thousand trees of reproduction size) are apparently more effective in removing soil moisture than the 70 square feet basal area of pine. Whether or not these relationships will exist during a summer with normal rainfall remains to be determined.

Removing Hardwood Sprouts with Herbicides

The three foliage sprays (Esteron 10-10, Esteron 2,4,5-T, and Esteron Brush Killer) used on hardwood sprouts less than 6 feet tall on the pine stocking study plots were sprayed on foliage during July and August 1952 at a concentration of one-half of 1 percent in water. An average of 83 gallons of solution containing 3-1/3 quarts of stock herbicide (4 pounds acid equivalent per gallon) was applied per acre.

These herbicides have apparently killed more than 75 percent of the sprouts. They also had an adverse effect on an additional 20 percent of the sprouts by causing the tops to die back, leaves

to fall off prematurely, and other abnormal growth conditions, all of which slow down the growth of the sprouts.

Thinning Hardwood Stands

A study designed primarily to test the effects of different degrees of release on reproduction has produced some interesting information on the effects of thinning on the growth of hardwoods in the Missouri Ozarks.

During the 11 years after thinning, the trees on the check plots had a net basal-area growth (excluding ingrowth) of about 11 square feet per acre. The trees on the plots that had 33 and 67 percent of the basal area removed grew (excluding ingrowth) 52 and 34 percent, respectively, more in basal area than those on the check plots. The thinning gave the better trees more room and this more than offset the decrease in the number of trees. The summary of these data along with data to be obtained on ingrowth will be completed next year and a manuscript prepared for publication.

Sprouting of Blackjack Oak and Associated Species

A report, "Sprouting of Blackjack Oak in the Missouri Ozarks," was released as Technical Paper 137. Trees were girdled by either peeling or notching and treatments were made during each month of the year. Fewer trees peel girdled sprouted than trees notch girdled and the sprouts on peel girdled trees were smaller. Also sprouting was less and sprouts were smaller on trees girdled during the active growing season (May, June, and July) than on trees girdled in the dormant season. Trees treated in June had fewer sprouts and the sprouts were smaller than those on trees treated in any other month. Sprouting also decreased as tree diameter increased.

Therefore, to keep sprouting at a minimum unwanted trees should be peel girdled in June, and priority should be given to girdling the larger trees.

Pruning of Black Walnut

The summary of data collected in a black walnut pruning study was completed and two reports were prepared. The first report, Station Note 78, deals with the time required to prune small walnut trees to different heights. It was concluded that under the conditions studied, pruning time does not limit the height of pruning up to 18 feet.

A manuscript entitled "Walnut Responds to Pruning" was submitted to the Journal of Forestry for publication. The 2-year response of pruned trees in terms of stem and height growth and sprouting are described. Although as much as 75 percent of the

live crowns was removed, growth was generally greater on the pruned trees. Only d.b.h. growth of trees pruned 75 percent was reduced and the reduction was not large. Sprouts on the cleared stems were common and as tree size and pruning intensity increased, the occurrence of sprouts increased. Sprouting may well be the limiting factor in determining the amount of live crown that can be eliminated in one pruning operation.

REGENERATION

The studies reported in this section are concerned with the establishment of new forests on coal-stripped and nonagricultural lands.

Conifer Species Adaptability

Work was continued on the conifer species-adaptability study plots planted in 1949 in Monona County in western Iowa and Allamakee County in the extreme northeast corner of Iowa. Twenty-three species of pine, juniper, spruce, fir, larch, and white-cedar have been used in western Iowa. The same species, plus a few others making a total of 31, have been used in northeast Iowa.

At both locations some replanting was done in the spring and all plots were checked for survival in the fall of 1953. Annual growth for 1953 and total height were measured on the plots which were established in 1949 and 1950. Later plantings were not measured.

The western Iowa plantation is a cooperative undertaking with the Forestry Department of Iowa State College. The planting is in the loess hills along the Missouri River. The soil is calcareous and the pH, especially in the top few inches of the soil, varies with degree of erosion and leaching. A relationship of growth with pH is becoming quite apparent and the Forestry Department is making a rather intensive study of this correlation. Soil samples have been taken throughout the entire 8 acres and tests of pH have been completed. A Technical Paper, of joint authorship, reporting on survival and growth of each species and on the correlation with alkalinity is planned for early issue. A report will be prepared also for the Allamakee County study.

Another planting was established in Pottawattamie County in the spring of 1953 to further test the conifer species that have shown the greatest promise in western Iowa. Fifteen species were planted on east- and west-facing slopes. However, the severe drought of the summer and fall killed most of the trees. Survival was good to very good for all species on July 2 but by November 4 only two species, eastern redcedar and Rocky Mountain juniper, remained

with satisfactory survival. Only 6.3 inches of rain fell between May 1 and November 4 and it came mainly as light showers--only one rain amounted to more than 1 inch.

The plantations in Monona and Allamakee Counties will require only a very little replanting in the spring of 1954 but the one in Pottawattamie County will be almost a 100-percent replanting job. In addition to the spring replanting work, survival counts and growth measurements will be made in the fall for some species.

Wood-Chip Mulch for Red Pines

The use of wood chips, placed around 2-2 red pines shortly after they were planted, resulted in significantly better survival and vigor after two growing seasons than in unmulched plots. But the wood-chip mulch had practically no effect on average height growth.

This information was obtained from a study established by the Forestry Club of Iowa State College using chips produced with the Ames Center wood chipper. A report on the study will be prepared soon.

Conifer Plantations for Management Studies

A plantation of approximately 12 acres of white and red pines was made on the Homestead farm of the Amana Society in the spring of 1953 for future use in thinning, pruning, and management studies. It was on a very sandy site and, like the plantation in Pottawattamie County, suffered heavy mortality because of the summer and fall drought. The area will be replanted in the spring of 1954.

Walnut Plantation in Northeastern Iowa

The walnut plantation made in Allamakee County in 1948 was inspected. There apparently has been much freeze-back of the tip of the trees each year since planting. This may be due to the source of the seed for the planting stock.

Planting on Old Fields and Spoil Banks in Ohio

Research to date has centered on planting old fields and spoil banks in Ohio. In the spring of 1953 a study was established to test the survival and growth of yellow-poplar when planted at spacings ranging from 3 to 8 feet from planted black locust. The objective is to determine how soon the locust becomes effective as a nurse tree as well as to determine the optimum spacing for these mixed plantings. The study tests both old-field and spoil-bank conditions.

In the past year a progress report was begun that summarizes the fifth-year survival and growth data for 13 planting studies on lands stripped for coal. Many of these experiments supply the basis for planting recommendations made to people actively engaged in reclaiming these lands. The report, largely statistical in nature, will be published in 1954 and will tabulate the survival and growth rates of all tree species tested under various conditions.

In our over-all program of testing stripped-land planting sites for forest trees, we have planted 19 different species of hardwoods and conifers in Ohio. Species tested include chiefly native trees and a few introduced pines that are also commonly planted. Graded and ungraded banks ranging from heavy clay to sandy shale, and from toxic acid to calcareous have been included in the tests.

A study on planting and ground preparation methods made in cooperation with the Ohio Power Company, the Muskingum Conservancy, and the Hanna Coal Company was 5 years old in 1953. Up to this time pines planted by machine in unprepared old fields survived and grew as well as pines planted by hand methods in costly pre-planting soil treatments. There also were indications, however, that yellow-poplar grew faster in height when planted in the lay of plowed furrows. Whether this early growth response will persist cannot be determined for several more years.

Soil Conditioner Tested

A polyelectrolytic resin soil conditioner was tested in 1953 for its value in aiding the early establishment of trees on a very adverse site. Shortleaf pine, planted in a borrow pit where all the surface soil had been removed, survived and grew equally well the first year with or without soil treatment. This plantation will be re-examined for 2 or 3 more years to look for possible delayed effects of the treatment. The same soil conditioner was used on spoil banks to test survival and growth of white pine, green ash, and yellow-poplar. A much higher survival was obtained for all species where the resin was disked into the surface. However, on plots where the resin was mixed with the spoils material around each tree the survival was lower than in untreated plots. There was not much difference in height growth between plots treated with soil conditioner and plots that were untreated.

Growth of Red and White Pine

In 1953 the results of a study made to determine the relationship between certain site factors and the growth of planted red and white pine were published. Both species showed increased height growth with increases in depth of the surface soil horizon.

However, growth decreased with increasing amounts of silt and clay in the surface soil. It was also of interest to find that both pines had faster height-growth rates in the mixed plantings examined than in pure plantings. Red pine diameter growth was faster in mixed plantings, but the diameter-growth rate for white pine was the same in mixed and pure plantings. The data showed that the height-growth rate of white and red pine in Ohio, at 25 years of age on average sites, is 2.0 and 1.6 times, respectively, the growth rates of these pines in the northern Lake States.

Seed Tests

In 1953, yellow-poplar seed collected from 13 stands located throughout the natural range of this species was sown in an Ohio nursery. Seeds from individual trees located at each source were sown separately. The objective is to study the range in seedling quality resulting from seed collected from individual trees as well as from different geographic locations. These seedlings will be further tested in field plantings.

Seed from 3 of the 13 sources was sown in separate beds in nurseries in Ohio, Indiana, and Illinois to test the effect of nursery practices and conditions on the quantity and quality of seedlings grown from a given lot of seed. The seedlings grown in this study also will be further tested in field plantings. The over-all objective of these studies is to determine the source of seed and the nursery practice methods that will assure high-quality planting stock for use in the area.

Reforestation of Coal-Stripped Land in Illinois

Two new studies were begun during the year on land strip-mined for coal. One involves a comparison of thinning techniques in young black locust coppice that has developed from an exceptionally good stand in Illinois that was cut for posts last year. The other study seeks to determine methods for successfully introducing desirable hardwood species into decadent black locust stands. Site quality has generally been much improved by the locust but competition from typically dense undergrowth of volunteer herbs and brush drastically lowers the survival and growth of underplanted trees. Methods being tested in Illinois and Indiana to reduce this competition include poisoning, burning, and cutting.

The unexpected development of highly acid conditions on mine banks a year or more after stripping has occasionally been responsible for costly planting failures. In a cooperative study with Southern Illinois University, a practical field test for estimating the concentration of acid-producing sulfides in mine-bank materials was perfected for use in preplanting examinations. By means of this test, the characteristics of sulfide occurrence in the overburdens

of a number of representative Illinois and Indiana coal seams were investigated and are described in Technical Paper 136.

Pine Planting on Old Fields

Four species of pine planted 13 years ago on claypan soils in southern Illinois now show large differences in relative success. The results were described in Station Note 76. At age 13 loblolly pine was the tallest and most productive. Shortleaf pine also made excellent growth but yielded less than loblolly. Survival of pitch and Virginia pine was good but trees of both species, especially Virginia, had poor form. Only the loblolly and shortleaf pines are straight and clean enough to produce any worthwhile volume of mine props, poles, piling, or saw logs.

Soil differences had a marked effect upon the growth of shortleaf and loblolly pines. Yields on the relatively deep, well-drained Ava and Bluford soils were about twice as great as on Wynoose, a shallower and more poorly drained soil.

Acorn Production in Forest Stands

A study to determine seed production of oak trees growing in natural forest conditions was started on the Sinkin Experimental Forest in cooperation with the University of Missouri Department of Forestry. The 1953 acorn crop on these trees was not only extremely light but many of the acorns were underdeveloped or malformed and were infested with insects.

Forestation of Strip-Mined Land

Work was completed on a manuscript, "Forest Planting on Strip-Mined Land in Kansas, Missouri, and Oklahoma," and it is scheduled for publication as a Technical Paper early in 1954. Planting recommendations for promising species are made for the 3-state region. In general, species recommended for planting are native to the area.

Walnut Seed Versus 1-0 Walnut Seedlings

The study of the relative survival and growth of walnut trees grown from nuts and from 1-0 seedlings was extended this year. The new plantings were made on the Sinkin Experimental Forest on an average Ozark site from which the low-grade hardwood stand had been removed by girdling and poisoning.

The first year more than 90 percent of the 1-0 seedlings survived--good survival for such a dry season. At the end of the first growing season, about 30 percent of the seeded spots had at least one seedling. This low figure is a result of low germination

since very little mortality of seedlings was observed. Judging by past studies, the number of spots with seedlings will about double next year as a result of delayed germination. The results of this study may vary from this depending on whether the dry weather was severe enough not only to delay germination but to dry out the nuts enough to kill them.

Planting of Chinese Chestnut

Hybrid chestnut plantations in Missouri were re-examined according to schedule. The survival was still good--more than 90 percent--and heights averaged a little more than 3 feet. No outstanding differences have developed so far among seedlings of the four different parents and no chestnut blight has been detected.

GENETICS

Success of Hybrid Aspen

Two natural hybrids of Populus, both apparently crosses between bigtooth aspen (P. grandidentata Michx.) and white poplar (P. alba L.), that show much promise have been found in southeastern Iowa on an upland site. Their discovery has been reported by Dr. A. L. McComb and Norman J. Hansen of the Forestry Department, Iowa State College, in an article submitted to the Journal of Forestry. The two clones are about 10 miles apart and in the southeast corner of Van Buren County. In form, vigor, and leaf and bark characteristics the two hybrids differ but little.

Both hybrids grow rapidly--much faster than any other upland species in the province. The largest tree in one stand had a breast-height diameter in 1953 of 15.2 inches at age 30 and a merchantable height of three 16-foot logs to an 8-inch top. Another has an 11-inch diameter at breast height at 20 years. The tallest tree is 99 feet high at age 30.

In cooperation with the Forestry Department of Iowa State College, samples from representative trees from both stands will be sent to the Forest Products Laboratory in 1954 for wood structure studies. The evaluation will consist of specific-gravity determinations, shrinkage studies, and examination of prevailing structural characteristics for comparison with aspen and aspen hybrids tested previously by the Laboratory. Stem cuttings and root sprouts will be used also for cooperative studies of propagation and to establish stands in other areas for test purposes.

Success of Hybrid Poplars

Examination of 50 different hybrid poplars planted on strip-mined land showed that, after 3 years, height growth was no better

than for native hardwoods commonly planted on these sites. This test of hybrid poplars in Ohio is being made in cooperation with the Northeastern Forest Experiment Station and the Ohio Reclamation Association as part of a large-scale study of the growth and survival of these trees on a wide range of sites. Further examinations of these plots are scheduled for the future.

Genetics Phases of Forest Planting

Three years after planting in southern Illinois, eight geographic sources of redcedar showed definite differences in both average survival and height. The study is still too young to furnish many conclusions but it does strongly indicate that seed from the southeastern seaboard should not be used in southern Illinois. Some differences in form and color are already apparent and these may become more pronounced as the trees grow larger.

The fifth-year remeasurement of two field-planted pine hybrids showed that a backcross of loblolly with a shortleaf-loblolly hybrid made slightly greater growth in the last 2-year period than did the best of loblolly collected from several geographic sources. A straight loblolly-shortleaf cross did much poorer. The average results for all plots at the end of the fifth year are as follows:

Hybrid or species	Total height	Height growth last 2 years	Survival
	(Feet)	(Feet)	(Percent)
Cross loblolly-shortleaf pine	7.9	3.3	87
Backcross loblolly-(loblolly-shortleaf)	10.2	4.6	80
Best loblolly source	10.6	4.5	89

Six additional hybrids, five loblolly-shortleaf and one loblolly-pitch pine, have grown 3 years in the field. Survival was good for all hybrids and average height ranged from 1.7 feet (loblolly-pitch pine) to 2.6 feet (loblolly-shortleaf backcrossed to loblolly). Loblolly and shortleaf planted at the same time averaged 2.8 and 2.2 feet in height, respectively.

The chief purpose of using hybrids is not necessarily to obtain the greatest growth, but rather a possible combining of the best hardiness and form characteristics of both species, together with good growth. The hybrids tested are hardy and have good form, but it is too early to draw definite conclusions.

Last spring a comprehensive test of rust-resistant chestnut was established on the Kaskaskia Experimental Forest in cooperation with the Division of Forest Pathology, U. S. Bureau of Plant Industry. Five strains of chestnut were planted in 30 plots on two different sites. Forested areas were cleared of trees in order to establish the plots on good forest soils. At the end of the driest summer in 75 years, average survival for all strains was 82 percent and the mean height was 2 feet.

Shortleaf Pine Seed Sources

A study of the effects of seed source on survival, growth, and quality of shortleaf pine was started this year as a part of a regional study of geographic seed sources of southern pines. The study involved the planting of 1-0 shortleaf pine seedlings from seven geographic sources of seed. The seedlings were planted on an average Ozark forest site after the low-grade oak stand was eliminated by a commercial timber sale followed by girdling and poisoning the rest of the hardwoods.

The trees with the lowest survival, 29 percent, were from seed produced in St. Helena Parish, Louisiana. Trees with the highest survival, 74 percent, were from seed produced in Burlington County, New Jersey. Trees from the local Dent County, Missouri, stand had the third highest survival, 69 percent. The over-all low survival and perhaps the wide range in survival is believed to be due to the extreme dry and hot summer. The rainfall during the growing season was less than 40 percent of normal.

FOREST INFLUENCES

The forest-influences problems are those related to soil stabilization and water-runoff control on the forested watersheds. Many aspects of research are involved in solving these problems. It is necessary to determine how forest covers of different densities and composition affect soil stability and water yield. It is also necessary to determine the site requirements of the important forest trees so that maximum timber yields as well as maximum soil and water benefits may be realized.

A temporary network of rain gauges was established on the Vinton Furnace forest in the fall of 1953 and a more complete weather station was set up at the forest headquarters site. Continuous weather records are an essential supplement to influences studies that will soon be established on the forest.

A tentative plan was prepared in 1953 for studying the effects of hardwood-to-pine conversion on the soil and water relationships for ridge sites. Amount of litter, soil depth and texture,

soil moisture, water runoff, and water evaporation will be investigated.

COSTS AND RETURNS

The basic objectives of a new utilization research program at the Carbondale Center are:

1. To determine and demonstrate ways to more completely and more efficiently utilize the hardwood timber available and to expand the use of low-quality trees and little-used species.

2. To integrate utilization studies into forest management research as an accessory to rehabilitation of hardwood stands through elimination of low-quality trees and little-used species.

To conduct this program, the Carbondale Center and the Southern Illinois University are cooperating in establishing a utilization pilot plant. The Research Center will use the pilot-plant facilities, in conjunction with other resources available, to conduct investigations designed to accomplish the basic objectives of the program. The University will use the pilot plant to train workers how to operate and maintain woodworking equipment on a production basis. The first 18 months have been devoted to recruiting a research staff, preparing research facilities, starting a problem analysis, initiating investigations, and assisting local wood-using industries. Specific accomplishments are as follows:

1. The University has erected a 55-by-208 foot building to house the pilot plant and is installing heat, water, light, power, and similar facilities. The basic pieces of modern production-type woodworking equipment have been purchased or are under contract. These consist of a variety saw, straight-line rip saw, swing cut-off saw, power-fed jointer, single-surface planer, and a single-spindle shaper.

2. In cooperation with Southern Illinois University and the Forest Products Laboratory, a test to evaluate hickory for out-of-doors stadium seats was begun. Four lots of hickory and one lot of Douglas fir seat slats were installed in the University stadium last fall. All the hickory was kiln-dried; three lots were given different preservative treatments. All of the seats were painted after installation.

3. A comprehensive and detailed study of skidding upland hardwoods was undertaken during the spring of 1953. Most of the field work, conducted at the Kaskaskia Experimental Forest, has been completed and data analyses are underway. The study consists of:

a. Determining costs of skidding hardwoods in standard log lengths and in tree lengths over different grades and distances, using three sizes of crawler tractors and several methods of skidding.

b. Determining weights of hardwood logs of different species and sizes. As one phase of this problem, moisture specimens of bark, sapwood, and heartwood were taken from the logs of three oak species immediately after the trees were felled. The results of these tests are tabulated below:

Species	Material	Green weight	Oven-dry weight	Moisture content 1/
		(Pounds per cu. ft.)	(Pounds per cu. ft.)	(Percent)
White oak	Bark	68.2	45.4	50.2
	Sapwood	71.6	38.1	87.9
	Heartwood	70.6	42.6	65.8
Black oak	Bark	72.0	49.5	45.5
	Sapwood	67.5	35.0	92.9
	Heartwood	72.5	39.0	86.0
Scarlet oak	Bark	80.1	52.5	52.5
	Sapwood	67.0	33.8	98.1
	Heartwood	71.5	37.5	90.7

c. Determining the resistance of loads of logs to skidding over different grades by three methods.

d. Determining damage to the residual stand resulting from skidding by the various tractor sizes and methods tested.

This study was conducted with the assistance of: Caterpillar Tractor Company, Hyster Company, Fabick Machinery Company, Taylor Machinery Company, Southern Illinois University, and the Forest Products Laboratory.

4. Assisted Southern Illinois University and the Forest Products Laboratory in initiating a study of the prevalence and location of gelatinous fibers in cottonwood. This work will aid in identifying external characteristics of logs and trees that are associated with tension wood in the species. Such information

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1/ Difference between green weight and oven-dry weight expressed as a percent of oven-dry weight.

will help users to recognize logs containing tension wood prior to their utilization. It will also aid forest managers in selecting for early elimination cottonwood trees that contain these fibers.

5. Consulted with and gave technical assistance to a new wood-using industry in the problem area and to the Physical Plant at Southern Illinois University. As a result, both are now using some local hardwoods in place of softwoods formerly shipped in from other areas. Another local concern asked for and was given information on the possibility of establishing a plant to manufacture pressboard from wood waste.

6. Actively participated in the Hickory Task Force, organized to study and aid in solving problems related to the management, marketing, and utilization of hickory.

FOREST FIRE CONTROL

Unprecedented drought and prolonged heat plagued the Missouri Ozarks in 1953. The precipitation during the months of May through September for the State was the lowest on record. This dry period was particularly harmful because it occurred during a longer period of subnormal precipitation.

One direct consequence of almost any drought is the high potential danger of forest fires. This potential was very serious in Missouri in 1953.

This year the peak of fire danger came in late September and the first few days of October before many of the hardwood leaves had fallen. Very few days of poor visibility, a general awareness of the great danger from a fire under such dry conditions, cooperation of rural residents, sustained fire-prevention activity, and prompt suppression action all helped prevent a major disaster. Losses could have been immeasurably greater. This, however, was little consolation to the men responsible for fire control who were kept constantly alert and active.

Fuels

Some indication of drought may be found through measurements of moisture content of litter, duff, and soil. Soil moisture decreased progressively from May through August at which time the sensitivity of the moisture meter used was not great enough to detect moisture. This condition prevailed throughout September. The soil directly underneath pine litter and duff had a moisture content of only 1.9 percent of oven-dry weight on September 17. The moisture content of the duff and litter averaged somewhat higher than that of the topsoil but some measurements were as low

as 7 to 10 percent. Oak litter in more open stands had moisture contents as low as 4 percent.

As a result of the extremely dry conditions, plant material in the soil, such as stumps and dead roots, burned for great distances underground. Heavy fuel on the surface was likewise completely consumed by fires. Hollow trees and snags were easily set afire. Many indiscriminate hunters still set smudges in den trees to smoke out squirrels, and this practice was responsible for a large number of fires. In normal years many of these fires would go out by themselves, but in 1953 a large number of these den-tree smudges caused reportable fires.

Observations were also made on the rate of deterioration of slash resulting from the thinnings made in the pine stocking study. A start was made in expanding this study to include the effects of different cutting practices on the amount of surface fuels.

Danger Rating

Analysis of records of fire occurrence and area burned in relation to ratings of the Central States Danger Meter was continued this year with emphasis on data from the Clark National Forest. This work is being done to test the meter as well as to find improved interpretations of the ratings.

It has been demonstrated that for an average of all the Clark Forest Ranger Districts there is a strong direct correlation between the number of fires per day and the daily maximum ratings of the 100-point Central States Danger Meter. In addition, the percent of days having fires, the average and maximum number of fires per day for days on which fires occur, and the size of the average fire increase as maximum daily ratings increase.

While good correlations were found when the combined data from all the districts were used, the most useful fire-occurrence correlation for local use is one made from the individual district records. The methods by which the first tests were made involve handling a large number of data and computing a number of regression lines, which the district ranger probably would not have time to do. A short-cut method, involving the "risk factor" term as devised by Lindenmuth and Keetch[2/] was used to obtain an estimated correlation for a district. This risk factor is the quotient of the number of fires divided by the sum of the daily maximum ratings for a given period. The risk factor multiplied by any rating, therefore, gives the number of fires per day expected for that rating. By

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2/ Lindenmuth, A. W., and Keetch, J. J. A measure of the severity of fire seasons. Fire Control Notes 2(1). January 1950.

plotting a few of these points and connecting them by a straight line the estimated regression line for the district can be obtained.

The values for the actual numbers of fires per day for various ratings for individual districts followed the trend of these lines in most cases. Where groups of actual values depart from the estimated line, the nature of the departure may be caused in large measure by the local influences on fire occurrence that are not integrated by the meter. A knowledge of the type of departure present on a district could help to guide the organization of suppression forces and may possibly bring to light considerations that may give better direction to the fire-prevention program for the district. An illustration of the short-cut method and one type of departure is found in figure 2. On this district when the meter rating increased above 32, the number of fires per day was much above the estimated number. This departure may well be the result of local peculiarities of risk.

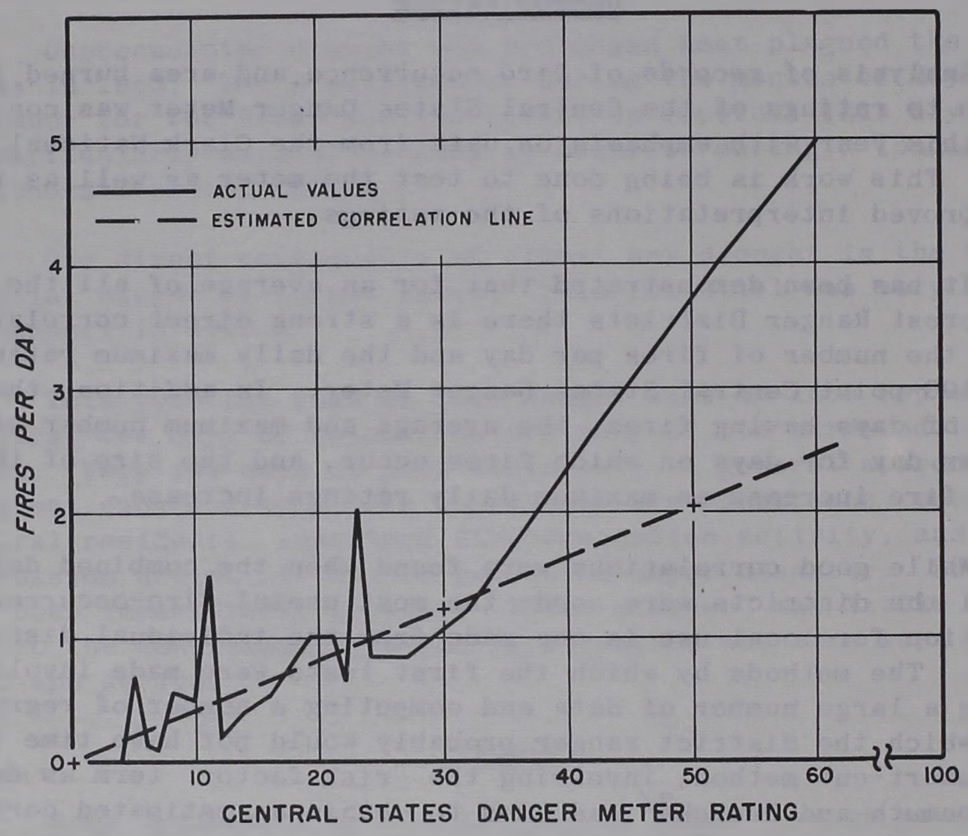

Figure 2.--Number of fires per day (actual and estimated) on one ranger district by short-cut method, using Central States Danger Meter ratings.

Another illustration of the use of the estimates of fire occurrence is in evaluating the effect of fire prevention. During

the five heavy fire months of each year 1946 to 1952 there has been a gradual decrease in numbers of fires in relation to the number that could have been expected. This reduction amounted to about 20 fires per year.

An article, "The Role of Burning Index in Fire-Danger Estimation," by John S. Crosby, was published in Fire Control Notes, Vol. 14, No. 2, April 1953. Since fire danger is made up of many factors, only a part of which are integrated in most danger or burning-index meters, the rating by itself is only an isolated statistic. However, when the rating is interpreted in terms of fire occurrence, fire behavior, difficulty of controlling fires, and possible damage, it is a sound basis for estimating fire danger and provides more precise information on which to plan and organize fire-control activities.

Fire Effects

Several plots have been established in newly burned forest areas to observe the effects of fires on the injury, survival, and growth of the trees. This year one new plot was established in a January burn in a hardwood stand and four plots each were established in burned and unburned portions of a young pine stand that had been thinned. In addition three other previously established plots in hardwood and pine stands were re-examined. Since rather complete information is available on the conditions under which these fires burned, the results will furnish indications as to the effects produced on growing stock at different levels of burning conditions.

RANGE MANAGEMENT

At the close of 1953, after two of the driest years on record, the Ozark cattleman is surrounded by problems. His reserve forage was used in 1952 and there has been no chance to grow more. His pastures, weakened by the drought in 1952, furnished even less forage in the dry summer of 1953. Many of them will have to be reseeded. Native range grasses have withstood the drought better than the tame grasses but they have not grown much or produced much seed.

Reduced herbage yields in 1952 and 1953 have increased grazing pressure. As usual, the preferred species and the more accessible sites were overgrazed first. But now, cattle are cleaning up the "little used" areas. Increased use of lower quality forage and more uniform distribution of grazing during drought suggest that light use of poor species and on steep slopes during the normal year is not objectionable. If enough unused range herbage is available, cattle can be fed a protein supplement and wintered on the range for much less than they can be wintered on hay that is purchased.

How can the Ozark rancher best recover from this drought and prepare for the next one? First he should plan his operation for the kind of season he can expect most of the time. That is, he shouldn't expect as much rain as he got in 1949, 1950, or 1951 but a great deal more than came in 1952 or 1953. Where he reseeds his permanent pasture he should use about the same species he used before. Even though seedings of orchard grass or tall fescue failed in 1952 and 1953, such cool season grasses will thrive in average years. And they produce more palatable forage over a longer season than do the more drought-resistant, warm-season grasses.

After the pasture has been re-established it should be grazed moderately. Pastures that were consistently overgrazed before the 1952-53 drought lost density faster than did pastures that had been grazed moderately. On a properly stocked range, forage growth should greatly exceed grazing use during the spring and early summer. Every effort should be made to preserve some of the excess spring growth as hay or silage.

The cattleman should also maintain his foundation herd. Present beef prices are unduly low because of the drought and Ozark cattle are not fat enough to top the market. If the rancher sells his cattle now he cannot expect to replace them at a reasonable price when he has feed again--when he has feed, his neighbors will have feed, too, and the demand for cattle will be high.

Forage Increases in Forest Openings

A report on the effects of removing overstory trees on forage production in Ozark forests is nearing publication. Grasses and forbs increased greatly in the openings left where large trees were cut. Almost all of the grasses and forbs were perennials. The frequency of grasses almost doubled and the frequency of forbs increased about one-fourth. Little bluestem (Andropogon scoparius Michx.) was the most abundant grass but the species which increased most strikingly were broomsedge (Andropogon virginicus L.) and the panic grasses (Panicum spp.). These species are less palatable than little bluestem but are grazed readily by cattle if other feed is scarce. Almost half of the forbs were legumes and about one-third were composites. These forbs, which increased by about one-fourth, are considered more valuable for deer than for cattle.

Removing overstory trees obviously increases herbage yields in the openings where trees are cut. However, the herbage increase is always shifting as new openings are created and old ones are closed out by trees. Deer can readily use the forage in these small, ever-changing openings but the cost of distributing cattle to the openings may be more than the forage is worth.

Control of Woody Plants

Two papers summarizing the practical findings of our plant-control research were prepared at the Research Center for publication by the University of Missouri. One paper (published in January 1954) is a short folder written for farmers and ranchers who merely want to know how to mix and apply 2,4,5-T, 2,4-D, and Ammate to kill brush, sprouts, or trees. The longer paper will be a bulletin containing the same general recommendations but with more explanatory material. It is intended for county agents and others who want to know more than formulas for mixing and applying herbicides.

Field work was completed in 1953 on all range-plant-control studies. The data from these studies are being summarized for publication. Scheduled work was also maintained on the cooperative plant-control projects financed by the Division of Forest Pathology. In one of these studies the data on more than 18,000 individual trees were recorded directly on IBM mark sense cards. The method proved to be entirely satisfactory in the field and made it possible to use machine tabulation without an intermediate transcribing job. With reasonable care the IBM mark sense cards can be marked and handled in the field without spoiling them for machine handling.

Range Reseeding

Final observations were made on reseeded areas on the Mark Twain National Forest in 1953. Most of the areas were reduced so much in density during the 1952-53 drought that they need reseeding. Stands that were consistently overgrazed before the drought thinned out faster than did moderately grazed stands.

Despite reseeding failures in 1952 and 1953, orchard grass and tall fescue appear to be well suited for the Ozark region. These cool-season grasses are more palatable than the more drought-tolerant, warm-season natives and furnish green forage over a longer period. However, an accumulation of native grasses on the range will carry the cattle through a dry period when improved pastures fail.

The intensity of the 1952-53 drought prevented big bluestem from flowering on the test plots in 1953. However, this species yielded a high volume of herbage in both years and was the most palatable of the native grasses. Results of reseeding tests suggest that big bluestem should be a valuable grass in the Ozark region. If planted on sites that can be mowed, big bluestem can be cut for hay in the average or good year when it is not needed for pasture. In drought years, the cattle can be grazed on the bluestem pasture or fed big bluestem hay.

PLANS FOR 1954

The Ames Center

Will continue work on...

1. Pruning of jack pine.

2. Reproduction following cutting.

3. Stand density for optimum growth. Establishment of the study at the Amana Experimental Forest will be completed.

4. Cutting-cycle comparisons. The third cut on the annual cutting-cycle plot will be completed before growth starts in 1954. The plot will be marked for the fourth cut in the fall and the stumpage sold.

5. White pine plantation thinning.

6. Hybrid aspen. Samples of representative trees will be taken to the Forest Products Laboratory for wood structure studies. Cutting and root sprouts will be used to establish the hybrid in test plantings at the Amana Experimental Forest.

7. Conifer species adaptability. The plantations will be replanted as necessary and survival counts and remeasurements made as conditions warrant.

8. Conifer plantations for management studies. The 12-acre plantation started last year at the Amana Experimental Forest will be replanted, and approximately 10 acres of new planting will be added.

9. Walnut plantation in northeastern Iowa. Try to determine reasons for annual freeze-back of terminal growth.

Will begin work on...

1. A series of management study plots at the Amana Experimental Forest. One definitely planned is a clear cutting of a small area of bottom-land timber to observe future production.

2. A reproduction study in an upland area that has been heavily pastured in the past.

Will report on...

1. Epicormic branching of oaks in southeastern Iowa.

2. Crown-competition-index method of controlling stocking.

3. Fuelwood-production costs in 1952.

4. Wood-chip mulching of red pine.

5. Pruning of jack pine in plantations.

6. Conifer-species-adaptability studies.

7. Yield of products from tie logs.

8. Returns from harvesting low-quality trees.

The Buckeye Center

Will continue work on...

1. Preparation of the preliminary problem analysis.

2. Organizing an advisory committee. A program conference will be held with an advisory committee consisting of people interested in the forest research program in the area. This committee will provide a liason between the research staff and the people who are directly concerned with applying the results of forest research. The committee will review accomplishments and plans at least once each year and aid the staff in directing the research effort to the problems of greatest concern.

3. Replanting yellow-poplar - black locust spacing study to maintain full stocking in all plots.

4. Field planting of stock in yellow-poplar source-of-seed study.

5. Cutting and establishment of the methods-of-management plots at Vinton Furnace Experimental Forest.

6. Cutting and planting plots in the pine conversion study.

7. Outlining forest-influences problems and study methods.

8. Plans for forest-influences studies on the Little Muskingum Watershed. This area, within the Wayne-Hoosier National Forest purchase-unit boundaries, is ideally suited for influences studies. The proposed tract includes the watersheds of Jackson and Irish Runs that drain into Archer's Fork of the Little Muskingum. These watersheds are sharply defined by a ridge and all kinds of land use are represented in the area.

9. Effect of preplanting soil treatments on mineral content in leaves of planted trees.

Will begin work on...

1. Thinning study in young upland hardwoods to establish optimum stocking guides for producing quality-hardwood sawtimber.

2. Plans for small-size-woodlot-management demonstrations.

3. Forest-influences study of the conversion of hardwood stands to pine. Data on soil moisture, surface water runoff, erosion, humus development, and soil profile changes will be taken.

4. Soil-site studies on the relationship between site quality of oaks and soil and topographic characteristics of southeastern Ohio.

5. Development of one or two small watersheds on the Vinton Furnace Experimental Forest for forest-influences studies.

Will report on...

1. Ground treatment and planting methods in Ohio.

2. The effects of soil depth, ground preparation, and planting methods on the early growth of planted white pine.

3. Forestation research on spoil banks in Ohio--fifth-year results.

4. Accumulation of litter beneath oak stands of southeastern Ohio.

5. Effect of forest cover on infiltration rates of water into soil.

The Carbondale Center

Will continue work on...

1. The annual cut and improvement treatments on the "good" farm woodland. Will also inspect the "poor" farm woodland to determine necessary treatments for maintaining good growing conditions. Make the first harvest cutting on the stream-margin woodland. Consider the desirability of holding a second farm forestry field day at the Kaskaskia Experimental Forest.

2. The scheduled treatments of compartments in the comprehensive forest management study. Five compartments will be given their second cutting treatment and past growth will be calculated.

3. Establishing the major study of response to release of pole-size white oak. The first remeasurements will be taken.

4. Study of reproduction on the mixed bottom-land hardwood plots.

5. Reproduction survey for upland hardwoods.

6. Cutting treatments on the 36 shortleaf pine thinning plots.

7. The systems-of-thinning study.

8. The pin oak thinning plots.

9. The loblolly and shortleaf pine plantations on Chicago, Wilmington, and Franklin Coal Company land.

10. Establishing the wood-utilization pilot plant.

11. An over-all problem analysis.

12. Assisting the University and the Laboratory in their study of gelatinous fibers in cottonwood.

13. Giving technical assistance to local wood-using industries as well as those investigating possibilities of starting new wood-using industries in the problem area.

Will begin work on...

1. A forest practice guide for timberland owners of southern Illinois (in cooperation with Southern Illinois University).

2. A detailed study of artificial pruning and cleaning of young upland hardwoods.

3. The pilot-plant part of the utilization research program.

4. A study in Indiana to test the effect of geographic seed source on the success of jack pine planted on coal-stripped lands and on old fields. The seed was obtained from 17 different localities in the Lake States region. Organizations cooperating in this study are the Indiana Coal Producers Association, Purdue Agricultural Experiment Station, and the Indiana Department of Conservation.

5. Establishing a study on coal-stripped land dealing with black locust coppice management. Underplanting of decadent black locust stands will be completed.

6. A series of studies on felling and bucking upland hardwoods with power saws (in cooperation with the Mall Tool Company).

Will report on...

1. Relation of white oak bark characteristics to growth.

2. Results of the redcedar seed source and pine hybrid studies.

3. Results of the comprehensive skidding study.

4. Growth after cutting in 10 upland hardwood stands.

The Northern Ozark Center

Will continue work on...

1. Cutting-practice levels for young second-growth shortleaf pine.

2. The effects of different intensities and methods of thinning young second-growth shortleaf pine stands on growth and quality of residual trees and on moisture content of the soil.

3. The effect of thinning second-growth hardwood stands on growth.

4. Effect of different intensities of pruning young black walnut trees on growth and quality and subsequent sprouting.

5. Chemical control of woody plants.

6. The production of acorns by trees in forest stands.

7. Direct seeding as a means of increasing the stocking of shortleaf pine in low-grade hardwood stands.

8. The growth and development of black walnut grown in mixture with black locust and several other species.

9. The relative value of using walnuts and walnut seedlings for establishing new stands of walnuts.

10. Suitability of Chinese chestnut to the better Ozark sites.

11. The relative survival and growth of shortleaf pine seedlings from seed produced in seven geographic regions.

12. Correlation of shortleaf pine tree growth and soil moisture.

13. The analysis of the Mark Twain National Forest records of fires and fire weather.

14. Analysis of the cumulative-burning-index data and determine its use in predicting fire occurrence and behavior during periods of drought. Explore other indices that may help to predict fire behavior and resistance to control.

15. The effects of fires on the trees in pine and hardwood stands.

16. Analysis of the 1952 range-burning study.

17. The kind and amount of fuel and changes in fuels on the Pine Stocking Study. Expand the study to determine the mass of litter and its depth on these plots from year to year.

18. Fuel moisture as related to weather conditions and to fire behavior.

19. The relation of relative humidity and wind velocity to fire occurrence.

20. The use of raked fire lines.

21. Key for Ozark range plants.

22. Cooperative plant-control project.

23. Study of forage in stands of shortleaf pine.

Will begin work on...

1. Methods of cutting hardwood stands.

2. Correlation of site factors and forest tree cover.

3. Shortleaf pine seed production under different methods of management.

4. Diameter-growth periods of shortleaf pine trees in stands of different densities.

5. Methods of using IBM cards for recording basic measurements and computing individual tree and stand volumes.

Will report on...

1. Effects of different intensities and methods of cutting young pine stands on structure of residual stands and yield of products.

2. Effect of thinning second-growth hardwood stands on growth.

3. Response of black walnut to pruning.

4. Response of planted pine and hardwood reproduction to overhead release.

5. Forestation of land strip mined for coal in Kansas, Oklahoma, and Missouri.

6. Effect of geographic seed source on survival and growth of shortleaf pine.

7. The use of raked fire lines on the experimental forest.

8. The need for livestock in the Missouri Ozarks--a brief of the range-problem analysis for presentation at the American Society of Range Management meeting in January.

9. Advantages of 2,4,5-T in low frills for killing unwanted trees.

10. Effects of fire on eastern redcedar.

11. Effects of foliage sprays on hardwood sprouts.

12. Observations on the establishment and use of reseeded areas on the Mark Twain National Forest.

13. Effects of basal treatments on hardwood saplings.

14. Effects of basal treatments on sassafras and persimmon.

15. Response of herbaceous plants to removal of overstory trees.

16. Effects of deer browsing on the composition of Ozark vegetational cover.

17. Predicting the probability of fire occurrence.

FOREST ECONOMICS

Research in Forest Economics at this Station is conducted in two major fields: (1) The Forest Survey and (2) marketing farm-woodland products. A certain amount of time is given to other economic investigations in connection with forest management and forest utilization research and Government defense programs as needs arise.

FOREST SURVEY

The Forest Survey is our largest activity, accounting for about 90 percent of our economics work. Our task is to take an inventory of the forest resources of the six central states plus Nebraska and Kansas. We determine forest area and timber volume, growth, and depletion, and report on ways for increasing the benefits from the forest resource.

When the Forest Survey began in this region in 1946 we planned to complete the initial inventory in 10 years. We are on schedule. Field work has been completed in Missouri, Illinois, Kentucky, Indiana, and Ohio and is progressing rapidly in Iowa. Final reports have been published for Missouri, Illinois, and Kentucky. The Indiana report is being prepared as are statistical releases for Ohio.

The recent surveys have shown slightly less forest land than was previously reported for the area surveyed to date. However, in the Corn Belt states of Illinois, Indiana, and Ohio, Forest Survey acreage figures exceed previous estimates. There is reason to believe that forest area is slowly increasing throughout the region as submarginal farmland reverts to forest. Missouri is the only state showing a marked decrease below previous figures. However, these early estimates were not based on field data and so were not particularly reliable.

The recent surveys also show a much greater volume of standing timber than was previously thought to exist. This does not mean that timber volume has greatly increased in the last few years. It does mean that our forest resources were greatly underestimated before the Forest Survey results came out. Part of the difference was undoubtedly caused by actual increases in volume, and another part is due to different definitions of forest land and of merchantable trees. But the greatest difference is due to the greater accuracy of the Forest Survey.

Perhaps the most striking result of the survey is the proof that the tide of timber depletion has turned. Growth of all timber

exceeds drain. So does growth of sawtimber, greatly influenced by the volume of young trees attaining sawtimber size each year. But from a quality standpoint, we are still overcutting. Large, high-quality trees are being removed faster than they are replaced. We need better markets for wood from small-size, low-quality, and cull trees and from logging and mill residues.

With the initial Forest Survey of the Central States more than 80 percent completed, the question is, what next? The first go-round is pretty much a Federal accomplishment, with less than 5 percent of the cost coming from other sources. Cooperation increased as survey results were published and found valuable. Both state and private agencies donated help in Ohio this year. In Iowa and Nebraska, the State Agricultural Experiment Stations are contributing manpower to double the field inventory work, plus other cooperation. There is sentiment for maintenance surveys that will keep estimates up to date and provide a basis for periodic reappraisals. Both the public and the forest industries would benefit from resurveys, which would show the trends in the forest situation.

In Forest Survey work opportunities arise for doing supplementary research at little or no extra cost. Examples this year are the cooperative surveys of parts of the Wayne-Hoosier National Forest, the photo cruise of the Dean State Forest in Ohio, and the special survey of the Amana Experimental Forest in Iowa. Results of these projects help the forest managers to prepare management plans or lay out research projects. When extra field manpower is needed, it is contributed by the cooperator. Other by-products of the survey include special timber-volume estimates needed for location of industries, for logging-equipment-sales programs, and for wood-procurement organizations of existing plants. Still others are the new methods and tools developed in the course of regular work, particularly in the field of photo interpretation. These have been described from time to time in Station Notes.

A major accomplishment of 1953 was the publication of the comprehensive report on the Forest Survey of Kentucky, "Kentucky's Forest Resources and Industries."

With the completion of field work in Ohio we have on hand the data from an extensive test of aerial photo survey methods. Results of this test will show the relative effectiveness of increasing photo interpretation while decreasing field work--in effect relying on photo estimates of timber volume corrected by field check.

The Timber Resource Review occupied the spotlight during the last half of 1953. The Station's main tasks for this project were to complete the Forest Survey of Ohio, to bring up to date previous survey figures for Missouri, Illinois, Kentucky, and

Indiana, and to prepare estimates of the forest situation in Iowa, Nebraska, and Kansas, for which figures were either lacking or badly out of date.

In the latter three states, forest inventory photo and field work for the TRR were done in sample counties by the regular Forest Survey method. This work not only provides a preliminary estimate of forest conditions but is actually a first installment on the Forest Survey of the three states. When the TRR is finished, the Forest Survey work will be a continuation of the job already begun, without duplicating work in the sample counties.

MARKETING RESEARCH

Marketing research at the Central States Station is devoted to finding better ways to produce and sell farm-woodland products in order to yield more income for the farmer while building up his forest property. During 1953, studies to help solve the problems of marketing farm-woodland products were carried on in Ohio and Kentucky.

In southern Ohio, several farm-woodland timber sales were studied to investigate the possibilities of farmers obtaining increased cash income from the sale of farm timber. The sales studied were ones on which a service forester had marked the trees for cutting. The studies indicate that farmers can increase their average annual income from their timberland if they (1) improve their growing stock by getting rid of cull trees, (2) make partial cuttings every few years, (3) select the right trees to cut, (4) spend some time and effort marketing their timber to the best advantage, and (5) invest their own labor and equipment in harvesting the timber. These are the things farmers do with their other farm products. However, on some of the sales studied, the farmers ignored the future income to be derived from good forestry practices. They chose instead to sell as they had in the past--clear cutting to a 12-inch or smaller stump diameter, leaving cull trees in the woods, selling all timber to one buyer as stumpage, and selling for a lump sum to avoid having to supervise the sale.

These practices indicate that much is yet to be done in research, extension, and demonstration before the average farmer will obtain maximum returns from his woodlands. An article on the increased returns one farmer obtained by good timber marketing was submitted for publication to a regional farm magazine.

Near the close of the year, marketing research received added impetus with the beginning of a cooperative project that more than doubled previous efforts. In Kentucky we began a survey and analysis of the markets for primary timber products. This study is being made in cooperation with the Kentucky Agricultural

Experiment Station, the Kentucky Division of Forestry, and the Cumberland National Forest. The study is expected to provide the following information: (1) A statewide directory of timber buyers, (2) specifications for timber products, (3) the relationship of timber volumes available for cutting to available timber markets, and (4) what future timber marketing research should be undertaken to help solve farm-timber-marketing problems.

PLANS FOR 1954

Forest Survey field work in Iowa will be completed in 1954 and work will begin in Nebraska. Surveys of the volume of timber cut and the current utilization practices will be made in Iowa and Nebraska. Photo interpretation, done in advance of field work, will begin in Kansas.

Statistical reports on the forest resources of Ohio will be published in the spring of 1954. The final report on the Indiana survey will be sent to the printer. We will complete nearly all of our assignment for the TRR by April.

The field survey of primary timber-products markets in Kentucky will be completed and a directory of buyers will be published. A second report exploring the opportunities for improved timber marketing in Kentucky will be prepared. The case studies of Ohio farm-woodland timber sales will be continued.

FOREST UTILIZATION SERVICE

CONSULTING AND ADVISORY SERVICES

Requests from the forest-products industries for assistance continue to increase as the work of the unit becomes better known throughout the territory. Servicing such requests could occupy the full time of the unit. While many requests can be handled by office conference or referral to qualified specialists at the Forest Products Laboratory or elsewhere, more and more require on-the-ground assistance. This type of individual service was extended to some forty industries or organizations last year on a wide-range of wood-utilization problems. Several times specialized personnel from the Laboratory or from other Divisions of the Station were called upon to assist on specific problems.

Such individual contacts provide an excellent opportunity to keep abreast of new developments and current problems in the forest-products-industry field. But it is also essential that some means be provided for broader evaluation of the field. Attendance at trade association meetings and technical and scientific conferences in part satisfies this need. Active participation in the Forest Products Research Society, both at the national and section levels, also greatly facilitates the work of the unit.

FORESTRY AND LOGGING SHOW

Major emphasis continues on the program of assisting small rural industries. The fifth forestry, logging, and sawmilling demonstration was held last October at Maramec Springs, Missouri. More than three thousand farm-woodland owners, sawmill operators, and wood-using-industry representatives attended the 2-day event. Approximately sixty manufacturers, distributors, and dealers in forestry, logging, and sawmilling equipment exhibited and demonstrated their products. The educational exhibits in forestry, fire prevention, and utilization were well organized and attracted unusual interest. These annual events are increasingly becoming a focal point for the exchange of ideas between the manufacturers of light logging and sawmilling rigs and the users of such equipment. The close cooperation among public and private forestry organizations, the forest-products industries, and the industry suppliers evidenced during the Missouri show caused widespread editorial comment.

HARDWOOD LOG GRADES

Industry acceptance of the need for uniform commodity grades continues to grow. Log grades were discussed at a meeting of the Timber Industry Committee of the Ohio Forestry Association. And the need for an over-all working plan to coordinate research in commodity grades was discussed with a number of workers in this field late last fall.

PULP AND PAPER

Periodically some individual or group in the Central States becomes interested in the possibilities of expanding existing pulp and paper facilities through the semichemical use of hardwoods. To date these efforts have been largely abortive. Our Forest Survey data indicate the resources are available and sooner or later we may expect progress in this field. The most likely possibilities appear to be in the lower Ohio Valley, in the Wabash Valley, or in Missouri since most of the inquiries have come from these areas. FUS attempts to keep abreast of these developments and currently provides information as requested by state and local chambers of commerce, development and publicity commissions, and interested industries, groups, or individuals.

The trend toward converting small corrugated board mills from straw to wood pulp continues. There are three such plants in Ohio alone, one of which is well along on its program. However, equipment at some of the straw mills is obsolete and this may present a problem in this program.

OTHER ACTIVITIES

Research Centers

FUS has technical responsibility for the utilization aspects of the research programs of the several research centers. With the exception of the Carbondale (Illinois) Center, research has not progressed to the point where logging or other utilization problems are given much consideration. Active logging has been underway at the Kaskaskia Experimental Forest in Illinois for several years and the new wood-utilization pilot plant at Carbondale is under cover and will soon be in operation. The first phase of a cooperative study of tractor-skidding costs and power requirements on the Kaskaskia Experimental Forest has been completed. FUS has participated in these research center activities to the extent possible.

Hickory Utilization Study

Both Day and Lane, in charge of the Carbondale Center, are members of the steering committee coordinating the research work on this species throughout its entire range. About fifty research workers and industry representatives met in Clemson, South Carolina, last spring to organize a task-force approach to the problems of hickory utilization.

PLANS FOR 1954

Emphasis for the coming year will be principally along the same lines as in the past. By the very nature of its activities, FUS cannot schedule its program too rigidly; flexibility of time to meet urgent requests for consulting and advisory services or to evaluate new utilization developments is essential. Briefly, the unit will continue cooperating with the wood-using industries in developing and putting into practice new utilization techniques and equipment. As the program at the wood-utilization pilot plant in Carbondale, Illinois, develops, requests for technical assistance can be expected to increase.

A forestry, logging, and sawmilling demonstration is planned for northern Illinois October 7 and 8. This will require a minimum of 6-weeks work. A small grade-recovery study in cooperation with the Forest Products Laboratory, Purdue University, and the University of Illinois may develop as a result of a request for an objective comparison of the FPL and the Purdue hardwood log grades. Several small sawmill clinics are tentatively planned, in cooperation with the FPL and the Extension Foresters of Ohio and Indiana.

PERSONNEL

(As of December 31, 1953)

ADMINISTRATION

PHILIP A. BRIEGLEB, *Director; Mary L. Posey, Secretary; Robert D. Wray, Editor; Virginia D. Simone, Stenographer

HOWARD C. AGER, Administrative Officer; Walter R. Hudgens, Chief Clerk; Robert W. Smith, John K. Vaughn, Ruth L. Hughes, Rachel E. Ford, Charles T. Singer, Arnold Ross, Amy E. King, Helen A. Curran

FOREST ECONOMICS

RUSSELL N. CUNNINGHAM, Chief (St. Paul, Minnesota); James T. Morgan; Edith D. Clark, Secretary

Forest Survey

Photo Interpretation -- Karl E. Moessner, **Forrest D. Freeland, Philip L. Thornton

Field Inventory -- Philip L. Thornton, James D. Burton, Arthur R. Eschner, **Roy A. Whitmore, Jr.

Statistical Procedures -- Chester E. Jensen, Margaret K. Peirsol

Computing and Compilation -- Lake F. Compton

Forest Industry Analysis -- O. Keith Hutchison

Farm Woodland Marketing Studies -- Kenneth L. Quigley

FOREST UTILIZATION SERVICE

RALPH K. DAY, In Charge; Virginia D. Simone, Secretary

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* W. G. McGinnies became Director as of January 1, 1954.
** LWOP to further education

FOREST MANAGEMENT

ARTHUR G. CHAPMAN, Chief; Evelyn E. Fitch, Secretary

Regeneration -- G. A. Limstrom

RESEARCH CENTERS

AMES, c/o Forestry Department, Iowa State College, Ames, Iowa

E. Garth Champagne, Forester-in-charge; Kenneth A. Brinkman, Margery O. Bornmueller

Amana Experimental Forest, Amana, Iowa

John E. Krajicek

BUCKEYE, c/o Ohio University, Athens, Ohio

Robert W. Merz, Forester-in-charge; Willard H. Carmean, Raymond F. Finn, Ruth P. Gross

Vinton Furnace Experimental Forest, McArthur, Ohio

William T. Plass, Clyde M. Morris

CARBONDALE, c/o Southern Illinois University, Carbondale, Illinois

Richard D. Lane, Forester-in-charge; David E. Herrick, Leon S. Minckler, Glenn H. Deitschman, Cleo Caraway, Betty J. Newlin

Kaskaskia Experimental Forest, Elizabethtown, Illinois

Benjamin A. Roach, Frank W. Kelso

NORTHERN OZARK, c/o University of Missouri, Columbia, Missouri

Franklin G. Liming, Forester-in-charge; S. Clark Martin, F. Bryan Clark, Mary A. Walker

Sinkin Experimental Forest, Salem, Missouri

Nelson F. Rogers, John S. Crosby, Wayne M. Harrison

PUBLICATIONS FOR 1953

Champagne, E. Garth

Covers protect small trees when spraying with herbicides. Sta. Note 79, 2 pp. Sept.

(Cones made of heavy paper and placed over valuable small trees protect the trees when herbicides are sprayed in the vicinity.)

Browsing deer discouraged by repellent. Sta. Note 80, 2 pp. Sept.

(A commercial repellent sprayed on small coniferous trees proved effective in protecting the trees from browsing deer in Iowa.)

Clark, F. Bryan

Time required to prune black walnut trees. Sta. Note 78, 2 pp. Aug.

(Pruning time for young black walnut trees 3 to 5 inches in diameter at breast height was found to increase directly with cleared height. Under the conditions studied, pruning time should not limit the height of pruning up to 18 feet.)

---------- and Liming, Franklin G.

Sprouting of blackjack oak in the Missouri Ozarks. Tech. Paper 137, 22 pp. Dec.

(Six-year results of girdling study have shown that sprouting varies with tree size, type of girdle, and month of girdling. Sprouting is less frequent on large trees, trees shallow girdled, and trees girdled in June. Sprouts are also smaller under these same conditions.)

Crosby, John S.

The role of burning index in fire-danger estimation. Fire Control Notes 14:10-11. Apr.

(Since fire danger is made up of many factors only a part of which are integrated in most danger or burning index meters, the rating by itself is only an isolated statistic. However, when the rating is interpreted in terms of fire occurrence, fire behavior, difficulty of controlling fires, and possible damage, it is a sound basis for estimating fire danger and provides more precise information on which to plan and organize fire-control activities.)

Day, Ralph K.
The wood pallet industry: its development and progress toward standardization. U. S. Forest Products Lab. Rpt. R1957, 21 pp. Sept.
(Outlines the development of the pallet industry and describes pallet designs and specifications. A glossary of terms and a selected bibliography are included.)

Deitschman, Glenn H. and Neckers, J. W.
Identification and occurrence of sulphides on land stripped for coal. Tech. Paper 136, 21 pp. (In cooperation with the Chem. Dept., South. Ill. Univ.) Nov.
(A practical field test that permits quick recognition of acid-producing sulphide deposits is described. Using this test, representative overburdens of the major strip-mined coal seams in Illinois and Indiana were examined to determine the localities, coal seams, and strata where concentrations of potentially acid-toxic materials commonly occur. Results of the survey are described and specific details of overburden composition are shown in accompanying charts.)

Finn, Raymond F.
Foliar nitrogen and growth of certain mixed and pure forest plantations. Jour. Forestry 51:31-33. Jan.
(Certain species of planted trees showed greater total heights when growing in associated tree covers than on old fields or bare spoil banks. Of the three types of tree covers studied, including black locust, the black locust cover was definitely superior to pine and sassafras in increasing foliar nitrogen levels and stimulating growth.)

Mineral content of leaves clue to white oak site quality. Tech. Paper 135, 12 pp. Nov.
(Reports the nitrogen, calcium, potassium, and phosphorus content of the leaves of white oak trees from 33 sample plots. The percentage of nitrogen in the leaves was found to be related to the site quality of the land and the thickness of the A soil horizon. It also varied with the position of the plots on sloping land, increasing with the distance down a slope from the ridge.)

Forest Survey Organization
Forest statistics of Indiana. Forest Survey Release 15, 36 pp. Jan.
(A 6-page summary of the results of the Forest Survey for Indiana, covering forest area, timber volume, growth, and drain plus 20 detailed tables.)

Gaiser, Richard N. and Merz, Robert W.
Growth of planted red and white pine in Ohio and Indiana. Tech. Paper 138, 14 pp. Dec.
(Summarizes the data from 100 plots in red, white, and mixed pine plantations. Height and diameter trends associated with age are given as well as site-index curves for both species in pure and mixed plantings. Site-index curves based on soil factors alone are also shown. The data indicate that, at 25 years, white pine and red pine in mixed plantings grow taller than in pure stands. White pine grew faster than red pine under all conditions examined.)

Hosner, J. F. and Lane, R. D.
Making farm woodland improvement pay. Tech. Paper 133, 12 pp. June.
(Results are reported for the first few years of managing two small, previously unmanaged woodlands at the Kaskaskia Experimental Forest. One of the woodlands was cut each year, taking a little less than the annual growth. The other one was given a heavy rehabilitation cut in one year and has had no further attention. Both tracts showed a small return after all harvesting and treatment costs were paid.)

Hutchison, O. Keith and Winters, Robert K.
Kentucky's forest resources and industries. U. S. Forest Serv. Forest Resource Rpt. 7, 56 pp. Washington.
(Describes forest resources and wood-using industries of Kentucky and recommends forest-improvement program.)

Lane, R. D. and McComb, A. L.
Effects of grass competition upon the establishment of hardwood plantations in Iowa. Iowa Agr. Expt. Sta. Res. Bul. 399, pp. 433-459. (In cooperation with Iowa Agr. Expt. Sta.) Aug.
(Studies of the effects of scalping, mulching, and root-pruning on the success of hardwoods planted in sod indicate that (1) mulching with inverted sod and planting in large scalps benefits seedling growth; (2) mulched scalps more effectively conserve soil moisture than unmulched ones; and (3) grass absorbs soil moisture more rapidly than hardwood seedlings.)

Limstrom, G. A.
A bibliography of strip-mine reclamation. Misc. Release 8, 25 pp. Dec.
(A selected bibliography of references pertaining to the reclamation of strip-mined land, plus a classified list of related literature.)

Limstrom, G. A. and Deitschman, Glenn H.
Early response to thinning of shortleaf pine in Indiana. Sta. Note 82, 2 pp. Oct.
(Heavy commercial thinning in a 14-year-old shortleaf pine plantation in southern Indiana resulted in increased diameter growth on the residual trees as well as an early financial return. Height growth was not affected.)

---------- Finn, Raymond F. and Deitschman, Glenn H.
How to grade yellow-poplar planting stock. Sta. Note 81, 2 pp. Oct.
(Describes method for grading yellow-poplar planting stock, based upon stem diameter of seedlings.)

Merz, Robert W.
Site-index estimates made easy. Jour. Forestry 51:749-750. Oct.
(Describes a meter for use in the field to estimate white oak site index. Surface soil depth, topographic position of the land, and aspect are the variables involved.)

Minckler, Leon S.
Good forestry practices can produce new wealth in southern Illinois. Gen. Telephone Co. of Ill. News 11:17-19. Apr.
(Reprinted in the April 15 issue of South. Illinoisan under the title "Private woods management lacking.")
(A general description of good forestry practices including: (1) Best species to plant for reforestation; (2) methods of handling native woodlands; and (3) an evaluation of financial returns from good forestry.)

Poor oak sites may grow good pine. Tech. Paper 134, 6 pp. June.
(Early results indicate that stands of oak-hickory on poor sites in southern Illinois may be converted to more valuable shortleaf pine by clear cutting and planting immediately or by planting pine in holes cut in the stand, provided the diameter of the holes is at least 1-1/2 times the height of the overstory trees.)

How thinning influences growth of pin oak. Tech. Paper 139, 8 pp. Dec.
(Pure pin oak stands, thinned to 65 square feet basal area, made more than twice as much net cubic volume growth as stands thinned lightly to about 92 square feet. Recommendations are given for managing pole-size pin oak.)

Minckler, Leon S.
Recent advances in the field of forest genetics. Ill. State Acad. Sci. Trans. 46:56-62.
(An outline of the problems in forest genetics and a discussion of recent progress and the goals of a forest genetics program.)

---------- and Deitschman, Glenn H.
Growth of thinned and unthinned loblolly pine in southern Illinois. Sta. Note 73, 2 pp. Mar.
(Plantations, aged 13 years, thinned to 81 square feet basal area made the same basal-area and volume growth as unthinned plots of 132 square feet basal area. After 4 years the trees in the thinned plots had better crowns and higher average quality.)

---------- and Deitschman, Glenn H.
Success of planted pines varies with species and site. Sta. Note 76, 2 pp. Aug.
(After 13 years loblolly and shortleaf pine planted on claypan soils were far superior to pitch and Virginia pine in form, height, and yield. The yield on a good soil (Ava) was about twice as great as on a poor soil (Wynoose).)

---------- and Lamendola, Paul E.
Growth of a well-stocked cottonwood stand. Sta. Note 75, 2 pp. (In cooperation with Ill. State Div. Forestry.) July.
(The dynamic nature of a well-stocked cottonwood stand at age 25 is shown. During a 4-year period the total volume increased from 14,400 to 21,050 board-feet per acre. Pole-size trees virtually disappeared but there was an increase of 22 trees per acre 17 inches d.b.h. and over.)

---------- and Roach, Benjamin A.
Girdling time for hardwoods. Sta. Note 77, 2 pp. Aug.
(Axe girdling was done at the rate of 6.5 square feet of basal area per man-hour for upland and 10.9 square feet for bottom-land hardwoods. Average girdling time per acre for upland timber was 2.3 man-hours. A formula is presented for estimating girdling time.)

---------- and Roach, Benjamin A.
Estimating girdling time. Jour. Forestry 51:824-825. Nov.
(The approximate time in man-hours required for girdling upland hardwoods was found to be 0.008 times the sum of tree diameters in inches.)

Moessner, Karl E.
An aerial photo scale-protractor. Sta. Note 74, 2 pp. Apr.
(Describes a photo interpreting aid that combines a small 1-1/2 inch protractor with the aerial photo scale.)

Photo interpretation in forest inventories. Photogrammetric Engin. 19:496-507. June.
(Describes uses of aerial photos in forest inventories, including methods used in classification and measurement of areas and stands, and summarizes the extent to which these techniques are now used.)

Quigley, Kenneth L.
Who owns Ohio's forests? The Ohio Conserv. Bul. 17:16-17. Dec.
(The forest land in Ohio is classified as to location and ownership. It is also pointed out that the forest area in Ohio is increasing.)

MANUSCRIPTS ACCEPTED BUT NOT PUBLISHED DURING 1953

Clark, F. Bryan
Black walnut responds to pruning. Journal of Forestry.

Limstrom, G. A., Finn, Raymond F., and Deitschman, Glenn H.
Planting stock grades for yellow-poplar. Journal of Forestry.

Martin, S. Clark
How to kill woody plants with chemicals. University of Missouri Extension Folder.

---------- Nichols, J. M., and Klingman, Dayton L.
Controlling woody plants to 2,4,5-T, 2,4-D, and ammate. University of Missouri Extension Bulletin.

Minckler, Leon S.
Observations on open-growth non-native conifers in southern Illinois. American Midland Naturalist.

Quigley, Kenneth L.
Ohio farm woodlands can be profitable. The Ohio Farmer.

TERRITORY SERVED BY THE

CENTRAL STATES FOREST EXPERIMENT STATION

FOREST SERVICE

U. S. DEPARTMENT OF AGRICULTURE